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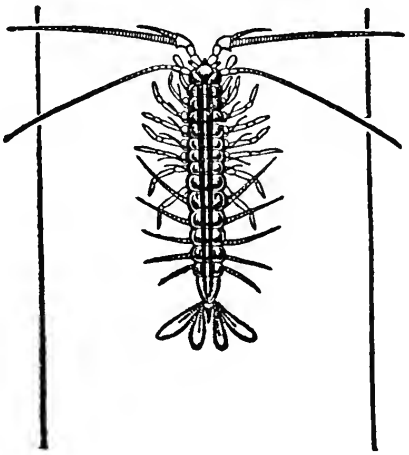

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ALBATROSS ISLAND, 1973

by

R. H. GREEN
Queen Victoria Museum, Launceston

Manuscript received 11/12/1973 *Published 26/7/1974*

INTRODUCTION

Albatross Island is situated in the western approaches to Bass Strait, about twelve kilometres west of the northern point of Hunter Island (lat.40°22'S., long. 144° 40'E.). It is about 1.5 km by 0.3 km and rises abruptly to a height of about 35 metres on the eastern side with a gradual downward slope to the west.

From the eastern aspect the most singular feature is a narrow, vertical-walled bay or gut, which cuts deeply into the island about 0.5 km from the north end. It terminates in a dense jumble of very large boulders. Beyond and continuing the line of this gut is a ravine which divides the island to the opposite shore. Its floor at the highest point is only a few metres above the present sea level.

On either side of the ravine and about 20 m above sea level are two large caves. Their openings are directly opposite each other and their long axes run NNE to SSW, indicating that they once formed a single cavern, which probably was cut by the action of the sea at a time when the whole island was lower in relation to the sea than at present. Each cave is about 100 m long, 15 m wide and up to 10 m high. The north cave opens on a boulder strewn gully which slopes down to a shallow bight at the NE corner of the island. The south cave opens into a large oval depression or hollow, about 100 m long and 25 m wide with precipitous walls rising to about 15 m above its floor. This natural cul-de-sac appears to have been formed by collapse of a portion of the original cave roof.

Owing to its relative isolation and exposure to the swell from the Southern Ocean, Albatross Island is difficult of access from the sea. The broken nature of the surface precludes a landing by light aircraft and the concentration of sea birds renders any attempt to land by helicopter dangerous.

Many naturalists have been interested in the island since George Bass landed there in 1798 to collect seals and albatross for fresh meat. There are numerous published references to the island and its fauna and a list is given in the appendix. The present author, together with others, succeeded in landing there for a few hours on 20 January 1960 (Macdonald and Green, 1964). On this limited visit 304 young and 4 adult White-capped Albatross were banded.

Records of the Queen Victoria Museum No. 51.

Recently the "Wild Australia Series", Special Projects, Australian Broadcasting Commission, Melbourne organised an expedition to make a film about the island and its albatross and invited me to join their party. The invitation was gratefully accepted. On 24 January 1973 the landing of ten personnel plus equipment and supplies for several weeks was successfully accomplished. Nine days were spent in filming, bird-banding, the collection of data and biological reference material and the party was picked up by fishing boat on the morning of 3 February 1973.

GEOLOGY

The following report on the geology of Albatross Island was written upon my request by Mr. F. L. Sutherland, Curator of Minerals and Rocks at the Australian Museum, Sydnev. The specimens have been lodged in the collection of the Queen Victoria Museum.

"Examination of submitted specimens and colour transparencies of Albatross Island indicate it is composed of massive, thicklv bedded siliceous conglomerate, containing some minor sandstone bands. The geology of the island was previously little known.

The rock is strongly cemented and consists largely of rounded to sub-angular fragments of quartzite and white to purplish indurated slate of shale. The fragments appear identical to and may be derived from the unmetamorphosed Precambrian successions outcropping on adjacent Hunter Island. From the photographs the bedding in the conglomerate appears to dip west up to at least 45°, giving gentler ramp-like dip slope surfaces on the west coast compared with the steeper more rugged undermined cliffs on the east coast.

These facts suggest that the conglomerate belongs to the folded basement rocks of Tasmania, lying within latest Precambrian to Mid-Devonian ages. Negative support for such an age is given by the absence of anv granite fragments in the rock derived from Carboniferous granite of Three Hummock Island, although pebbles of this granite presently wash up on Albatross Island beaches. The conglomerate closely resembles Cambrian and Ordovician conglomerates known on the west coast of Tasmania, but such outcrops are not known close by so that the Albatross Island occurrence is important in extending anv of their palaeo-geographical reconstructions. Structurally, Lower Palaeozoic rocks could be expected in this position as the Precambrian beds on western Hunters Island dip westwards and if extended would dip under anv overlying Palaeozoic beds. The possibility of faults down-throwing the basement rocks west of Hunter Island also exists, based on evidence of such throws on its west side and the extension of linements marked by Tertiary volcanic fissure eruptions from Cape Grim through Trefoil and Steep Islands."

BOTANY

The vegetation of the island is confined to a few low growing species and lacks trees and large shrubs. Most species possess thickened leaves, typical of vegetation growing on small, exposed islands and subjected to the influence of sea spray and above average salinity.

Species collected and lodged in the Queen Victoria Museum herbarium are as follows:

FILICES:

Asplenium obtusatum, Shore Spleenwort. Three small, well separated clumps were found. Each was growing from deep sheltered crevices in the rock face.

GRAMINEAE:

Poa caespitosa, Tussock Grass. Common and well distributed over much of the top of the island especially on the light sandy soil in the vicinity of the Mutton Bird burrows.

CRUCIFERAE:

Lepidium foliosum, Sea Cress. Scattered about the island in small clumps, usually sheltered amongst the rocks.

GERANIACEAE:

Pelargonium australe, Native Perennial Pelargonium. A Few odd plants scattered about the island.

FICOIDEAE:

Disphyma australe, Round-leafed Pigface. Occurs in thick carpets over much of the island, especially in the valleys and places which receive water from run-off or seepage.

Carprobrotus rossii, Pigface. Small clumps are scattered about the island in association with the previous species.

Tetragonia implexicoma, Ice Plant. A few clumps are to be found, mostly growing from crevices or ledges where it sometimes hangs in long trailers.

UMBELLIFERAE:

Apium prostratum, Sea Parsley. A few small scattered clumps, usually in the shelter of rocks and crevices.

COMPOSITAE:

Senecio spathulatus, Rookery Senecio. Common and well distributed over the more elevated areas especially about the Mutton Bird rookeries.

APOCYNACAEA:

Alyxia buxifolia, Box-leafed Alyxia. A few plants occur in the shelter of rocks and crevices.

CHENOPODIACEAE:

Chenopodium album, Fat-hen. An introduced plant occurring in a few restricted patches.

Rhagodia baccata, Coastal Saltbush. This occurs commonly, especially in the boulder strewn areas.

Salicornia quinqueflora, Samphire. Scattered about the island, especially about the crevices and steep areas.

MAMMALS

No evidence of the presence of terrestrial mammals could be found despite a careful search for droppings and other signs.

Though seals were once numerous, as evidenced in accounts of the early explorers and sealers, only odd invidiuals now visit the island. During our stay about five sightings were made of the Australian Fur Seal *Arctocephalus pusillus doriferus* on or near to rocks on the shore. At least three individuals were present, one of which had been tagged as a pup on Seal Rocks near the Victorian coast (pers. com. Robert Warneke).

BIRDS

Species mentioned include land birds and those sea birds breeding or resting on the island. Casual observations of sea birds seen flying past the island have been excluded.

Little Penguin *Eudyptula minor*. This bird was found in hundreds scattered over the island in burrows and rock crevices.

Their young were well advanced and some apparently had vacated their nesting sites just prior to our visit. Several adults were found moulting. Sixty-six young were flipper banded. A few had bred in or beyond the south cave and were unconcerned by our presence as they made their way past our camp to their nesting sites.

White-faced Storm-petrel *Pelagodroma marina*. Four desiccated carcases, one of which was a well-feathered nestling, were found but live birds or other evidence of breeding was lacking.

Short-tailed Shearwater *Puffinus tenuirostris*. Burrows of this "Mutton Bird" were numerous on the more exposed areas where the sandy soil permits their establishment. This was principally the more elevated central part of the island. Hundreds and possibly thousands were breeding there, the burrows then containing large downy young.

Fairy Prion *Pachyptila turtur*. Many hundreds were found breeding in burrows, beneath the vegetation and in rock crevices all over the island. Some young were still in down, the feathers just commencing to erupt, while others were well feathered. Several had bred beneath boulders inside the cave and showed very little concern for our presence when entering and leaving to tend their young at dusk and dawn.

Diving Petrel *Pelecanoides urinatrix*. The desiccated carcase of an adult was found on top of the island. No other evidence of this species could be detected. It breeds on nearby Black Pyramid (Green and Macdonald, 1964).

White-capped Albatross *Diomedea cauta*. When Bass and Flinders dicovered and named Albatross Island in December 1798, Flinders (1814) described it as appearing to be "almost white with birds". This impression was gained as he approached from the east where the high cliffs would prevent him from seeing much more than the very edge of the island. Bass landed on the north-east end and collected seals and albatross for fresh meat but gives little additional information as to the extent of the albatross colony.

George Augustus Robinson (Plomley, 1966) visited the island in October 1832 and found that "the top of the rock from one end to the other was covered with albatross". As was the case with Flinders the impression was gained as his party rowed northwards along the eastern shore where, on top of the cliffs, birds were seen perched in great numbers. Robinson stated "Originally those birds covered the whole surface of the island completely with their nests but destruction since has been very great amongst them." This depredation was the work of sealers who killed the albatross for their feathers, the product of three birds weighing a pound (0.45 gm) and which were sold to merchants in Launceston for from nine pence (8¢) to one shilling (10¢) a pound. Robinson refers to the intolerable stench occasioned by the putrid carcases of the albatross which lay in heaps in different parts of the cavern.

It is clear from Robinson's account that the population must have originally numbered many thousands but at the time of his visit it had already suffered a significant decline due to human predation. This decline must have continued almost to the point of annihilation for, when Le Souef and Ashworth visited there in November 1894 (Le Souef, no date), they found "The largest colony contained about three hundred nests and the smallest, six." Ashworth and Le Souef (1895) estimated the total to be 400 nests - apparently just the fragmented remains of the once vast colony. On 6 November 1909 Atkinson and Armstrong (North 1914) found 250-300 nests. In December 1927 Thomson (1928) found "The birds had

evidently increased in numbers since the visit of Mr. Dudley Le Souef." In 1960 there were about 670 occupied nests (Macdonald & Green, 1964) and the 1973 visit here dicussed revealed about 1500 occupied nests (see table 1).

ROOKERY	ESTIMATED OCCUPIED NESTS	
	1960	1973
Main	500	1100
North-east	110	250
South-east	56	130
West	10	25
Total	676	1505

TABLE 1. Estimated number of occupied nests of *D. cauta* at the time of the 1960 visit (Macdonald and Green, 1964) and the 1973 visit. Figures are based upon birds banded and counts.

Exposed areas of rocks, now well beyond the limits of the main rookery, were found to have a smooth, worn, white crust. This was suspected to be evidence of the once much larger colony and samples were collected for analysis and submitted to F. L. Sutherland. His report is as follows:"The material forms whitish grey, laminated crusts on the rock and X-ray diffraction examination showed that it is basically amorphous in structure. A light element X-ray flourescence scan showed Ca and P as major and Fe, Ti, K, Cl, S and Si as minor elements suggesting that it is probably calcium phosphate and could represent material derived from old guano deposits."

Robinson refers to such deposits when describing the rocks as being "covered with an enamel of silvery polish which I suppose to have been formed from the excrescence of the birds and is very difficult to walk on, slippery as ice." (Plomley, 1966).

The distribution of this material extends from the main rookery, being bounded by the sea cliffs to the east, the cliffs above the bay to the north and extending eastwards onto the rising ground in the centre of the island.

From the earlier published accounts it is possible to postulate on the population trend over the past 200 years (see fig.1). The decline appears to have been arrested about the beginning of the century and the colony now is slowly increasing in number, though still far below its former splendour.

The young appeared to vary in age by no more than two or three weeks. In many the wing feathers were well erupted and some young were observed beating the air as if for wing exercise. In general appearance the rookeries looked strong and healthy, with less dead birds than was the case in 1960. Some of the young were distressed by the presence of large numbers of ticks which attach to the naked skin beneath the mandible. Some severely infested chicks, which were wasted in appearance and had heavily soiled plumage, were so affected that their survival was doubtful. Under these circumstances it seemed likely

that at least some of the dead chicks found had died from this cause. The smaller colonies appeared to be more severely affected than the larger and more concentrated ones. The average mortality might approximate ten per cent. There were a few unoccupied nests in all the colonies most of which were probably the result of early nestling mortality, or egg loss. Three addled eggs were found in deserted nests two of which measured in mm 102 x 68 and 97 x 66. Silver gulls were often in close attendance during feeding to scavenge discarded or regurgitated food items.

Food samples were collected from 75 young by prompting them to vomit into a plastic bucket. The material was preserved in 4% formalin for later identification. An analysis of this material is given in table 2. Some additional material was collected at random when birds vomited during banding operations. Some samples were collected in the morning and others in the afternoon without any noticeable difference in volume and content.

ITEM	NUMBER	PERCENTAGE
Unidentified fish	24	32.0
Scad *Trachurus declivis*	15	20.0
Black fish (not determined)	4	5.3
Red Snapper *Trachichthodes gerrardi*	1	1.3
Cephalopoda (flesh and beaks probably of squid)	38	50.7
Cephalopoda (cuttle bone from cuttle-fish)	2	2.7
Prawns *Gnathophausia* sp. (*ingens*?)	22	29.3
Small prawns (Euphasids?)	1	1.3
Broad Fish-louse *Livoneca* sp. (*raynaudi*?)	2	2.7
Tongue-biter *Codonophilus* sp. (*imbricatus*?)	1	1.3
Salp-like remains	24	32.0
Woody stems	9	13.0
Pebbles	11	14.7
Dry grass	5	6.7
Lumps of Dung	5	6.7
Opaque strands	3	4.0
Empty, except for oil	19	25.3

TABLE 2. The items found in the spewtum collected from 75 nestling albatross and the number and percentage of birds in which they were represented.

It is not suggested that the total gut contents were vomited in each sample for, to limit undue stress, each nestling was handled for only a few seconds. Though the itemised percentages may have been higher if the complete contents had been extracted, it is likely that they would have remained in the same relative order of importance. Oil was present in every sample and in 19 (25.3%) was the only material produced. It varied greatly in quantity and the colour ranged from

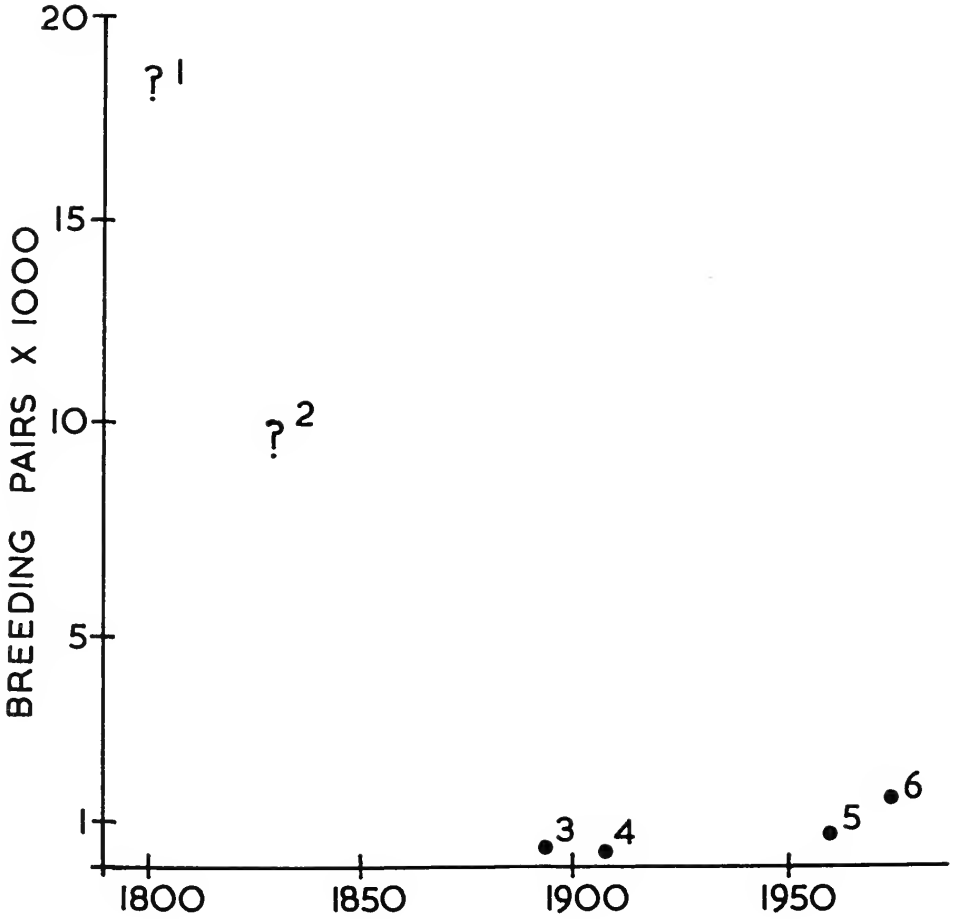

FIGURE 1. The numerical decline and partial recovery of the *D. cauta* population on Albatross Island as indicated by the account of:

1 Flinders; 2 Robinson; 3 Le Souef & Ashworth; 4 Atkinson & Armstrong; 5 Macdonald & Green; 6 the present author.

PLATE 1. Albatross Island from the East.

PLATE 2. White-capped Albatross.

PLATE 3. General view of part of the main albatross colony looking northwards.

PLATE 4. Banding of nestling albatross in 1960.

grey to yellow and orange and was apparently dependent upon the associated food. Samples were weighed and ranged from 80 gm to 1050 gm. The stage of digestion of most of this material was such as to render determination difficult, if not impossible.

Nematodes were present in almost every sample and in some were very numerous. These have been determined as *Stomachus* sp., probably *S. diomedea* (Family ANISAKIDAE), which have previously been recorded in other albatross species (Munday & Green, 1972).

Scale fish, squids and prawns were most numerous with three species of fish being represented. When identifiable fish remains were present, the remaining unidentifiable pieces of fish from that sample were concluded to be of that species. Forty four (58.7%) of the samples contained fish remains. If the unidentifiable samples are attributed to Scads and the undetermined black fish in the proportion of three to one as indicated in table 2 then 33 (44%) of the samples contained Scads and 11 (14.7%) contained black fish. The state of digestion of the fish in the samples suggested that they had been swallowed head first. In the case of large specimens digestion had progressed from the head anteriorly as the fish slipped slowly into the bird's gut, partial digestion occurring before being presented to the young. Several almost complete caudal sections were found but skull fragments were rarely present. Two small Red Snapper of total length of 110 mm (one from the series sampled and one otherwise collected) were almost entire and digestion had commenced evenly over their whole length, their smaller size apparently having permitted the bird to completely swallow these fish. The vertebrae was the last section to digest. The robustness and length of some vertebral sections indicated that fish in excess of 400 mm long are often taken and passed to the young. At least two samples contained Scads which would have been of this size.

The prevalence of squid remains in the gut samples together with vast numbers of their mandibles scattered about the vicinity of the rookeries indicates that this is an important food item. The mandibles do not digest but apparently pass through with faeces or are regurgitated. In many samples mandibles were the only remaining evidence of the squid. The greatest number taken from any one individual was 11 (in two instances). A high percentage of these could not be matched as pairs and it was usually concluded that the number of individuals represented was more than half of the mandibles present. They varied greatly in size, ranging from a length of 8 mm to 40 mm.

A freshly regurgitated portion of squid comprising the head and basal parts of the arms was picked up in the middle of the main rookery. It measured 150 x 80 x 80 and weighed 350 gm and apparently had been too large for the young bird to swallow. One squid, of a total length of 83 mm was determined as *Nototodarus gouldi*, a common species in Bass Strait.

Prawn remains usually consisted of parts of the exo-skeleton only and were comprised of individuals which would have been about 150 mm in body length.

The Broad Fish-lice may have been inadvertently swallowed while still attached to host fish. Their relatively undigested state in relation to the rest of the sample suggested that they were taken separately, though the possibility of their being more resistant to digestion cannot be discounted.

Small prawns, probably belonging to the Family PANDALIDAE were present in considerable quantity in one sample, which also contained the remains of a large black fish. This suggests the possibility that it may have initially been swallowed by the fish which in turn was swallowed by the albatross.

The Salp-like remains were mostly of about 30 x 5 x 3 mm but some larger specimens were also found. They were mostly entire and appeared to be slow to digest.

Woody plant stems to 35 mm long, a little dry grass, pebbles ranging in size from about 50 x 30 x 20 mm to 3 x 2 x 2 mm and lumps of dung of about the same dimensions were apparently taken from the vicinty of the nest and not fed by the adults. The young were sometimes noticed manipulating such items in their beaks but swallowing of these was not initially suspected. Seventy-eight pebbles was the greatest number found in a single sample.

One Rock-carb *Nectocarcinus integrifrons* was collected from the vomit of a young bird during banding operations and is an additional item to those in table 2.

Adults were found about the colonies at all times but it was noticeable that the number increased in late afternoon and evening with some still returning after dark. Almost invariably their approach to land and flight initiation was made into the wind. This obviously assists in reducing landing speed in the first instance and in providing lift and buoyancy in the latter. Returning birds usually made their landing beside or near to their nests, while flights were usually initiated from a high ledge or cliff top from which the birds could drop into the wind. No evidence could be found to support an old theory that the pit in the centre of the island acted as an albatross trap, resulting in the death of many birds. This appears to have been mis-interpreted by some visitors due to the accumulation of albatross remains deposited there by the sealers.

On a number of occasions adults were observed to escape from the pit, either by working their way up the ledges or simply by walking out through the south cave.

A watch was kept by all members of the party for banded adults but only one was found. This bird was sighted on one occasion when feeding a young. It was captured and found to have been banded as a nestling on 20 January 1960. The aluminium band was heavily worn, mostly on the inside and was replaced by a new band. The lack of sightings of banded adults suggests that it is now unlikely that further recoveries from the 1960 banding will be made. Table 3 presents details of the recoveries to date. Nine hundred and ninety-eight young were banded during the 1973 visit and table 3 includes the recoveries from these birds to the time of submission.

Black Cormorant *Phalacrocorax carbo*. One seen once on the north-west point of the island.

White-breasted Cormorant *Phalacrocorax fuscescens*. Up to six were seen on several occasions on the north-west point.

Silver Gull *Larus novaehollandiae*. Over 100 were resident on the island during our visit. A small rookery of about 25 pairs was found on the north end and another of about 15 pairs on the south end. Breeding had almost finished and most young were flying. Food is regularly scavenged from the albatross colony when spilling from regurgitation occurs.

Pacific Gull *Larus pacificus*. Two pairs were resident on prominent points on the south end of the island. Though their nests or young were not found, their behaviour indicated that they were probably breeding.

Sooty Oystercatcher *Haematopus unicolor*. Four were regularly seen round the rocky shore line.

White-faced Heron *Notophoyx novaehollandiae*. One was seen on several occasions on the southern point.

Swamp Harrier *Circus approximans*. Odd birds were seen flying above the island on most days. Soon after sunrise on 2 February 1973 at least 12 were counted slowly moving northwards. Though some came low over the island none attempted to land and none showed interest in the albatross. The majority appeared to be dark in colour and therefore young individuals.

White-breasted Sea-eagle *Halliaeetus leucogaster*. An adult pair was seen on numerous occasions. Several nests were found on the cliffs above the bay and one appeared to have been occupied in the current season. The birds were shy, appearing to be wary of our presence.

Nankeen Kestrel *Falco cenchroides*. Two were seen on 1 February 1973 and another on the following day.

BAND NO.	DATE OF BANDING	DATE OF RECOVERY	HOW RECOVERED	PLACE (b.p.= BANDING PLACE)	DISTANCE (km) and DIRECTION
140/01055	19/1/1960	-.5.1960	Dead	At b.p.	-
140/01033	"	9.6.1960	Alive	19 km E. Woollongong N.S.W.	885 N.E.
140/01044	"	15.7.1961	Dead	West Rosebud beach, Port Phillip Bay, Vic.	225 N.
130/14077	"	6.11.1961	Dead	Maatsuyker Is., Tas.	386 S.S.E
130/13082	"	10.5.1962	Alive	Robe, S.A.	563 N.W.
"	"	17.5.1962	Dead	Near Southend about 80 km S.E. of Robe, S.A.	485 N.W.
130/13023	"	7.11.1962	Alive	At b.p.	-
140/01041	"	7.11.1962	Dead	At b.p.	-
130/13019	"	1964	Dead	No data provided by finder	
130/14076	"	15.11.1967	Dead	16 km N.W. b.p.	16 N.W.
130/14056	"	13.4.1969	Alive	113 km S. Cape Woolamai, Vic.	113 N.N.E
130/14028	"	5.10.1969	Alive	16 km W.Currie King Is.	97 W.N.W
1070	"	26.1.1973	Alive	At b.p.	-
130/22272	31/1/1973	11.4.1973	Alive	Between Albatross Is. & South Black Rock	11 S.
140/42152	"	13.4.1973	Alive	5 km N.W. North Black Rock	8 N.N.W
140/05188	"	14.4.1973	Dead	8 km W. Hunter Is.	5 E.
140/02028	"	24.4.1973	Dead	5 km S. of Arthur River N.W. Tas.	80 S.
130/22142	"	31.4.1973	Dead	Three Hummock Is., N.W. Tas.	19 E.S.E
140/02023	"	17.5.1973	Dead	Barwon Head, Vic.	233 N.
130/22209	"	14.7.1973	Dead	3 km S. of West Pt., N.W. Tas.	64 S.
140/42152	1/2/1973	13.4.1973	Alive	5 km N.W. of North Black Rock, Tas.	5 S.
140/42110	"	30.4.1973	Dead	16 km N. Kingston, S.A.	580 N.W.

TABLE 3. Recoveries of White-capped Albatross banded on Albatross Island, Tasmania.

Welcome Swallow *Hirundo neoxena*. Three were seen flying northwards over the island. An unoccupied nest was found on a small ledge inside the northern entrance of the south cave.

Australian Tree-martin *Hylochelidon nigricans*. A group of five and another of two were seen flying northwards over the island.

Australian Pipit *Anthus australis*. One was seen on several occasions on the top of the island.

Raven *Corvus tasmanicus*. Up to three were seen several times.

Blackbird *Turdus merula*. One was seen on several occasions, usually in or about the entrance to the northern cave.

Skylark *Alauda arvensis*. One was seen twice on top of the island.

Starling *Sturnus vulgaris*. Approximately 100 were living on the island. During the day they were scattered in several small flocks.

FISH

A number of fish were collected at various points round the island by D. Milledge and the following specimens having been added to the collections of the Queen Victoria Museum.

Trachipterus arawatae, Ribbon Fish. One specimen (1973/5/59) was speared about 50 metres off shore from the bay. It was observed swimming with the longitudinal axis vertical which, together with its sluggish nature, suggested that it may have been sick or injured.

Latridopsis forsteri, Bastard Trumpeter (1973/5/38). Two speared on the western side.

Scorpis aequipennis, Sea Sweep. Two (1973/5/39) speared in the bay.

Atypichthys strigatus, Mado. Three (1973/5/29) speared in the bay.

Bovichtus variegatus, Dragonet. One specimen (1973/5/60) was caught by hand in a sheltered tidal rockpool on the south-west of the island.

Pseudolabrus cyanogenys, Parrot Fish. One (1973/5/37) speared in the bay.

Aracana aurita, Shaw's Cowfish. One (1973/5/35) collected by hand in the bay.

REPTILES

Lizards were found to occur all over the island and were particularly numerous in the valley between the east and west gulches, in the "pit" and near the cave entrances. Two species were collected for the collections of the Queen Victoria Museum.

Leiolopisma pretiosum, Small-scaled Skink. This was by far the more numerous species. Fifty-two specimens (1973/3/2) being collected.

Leiolopisma metallicum, Metallic Skink. Found living in close association with the preceding species. Four specimens (1973/3/3) were collected. The colour pattern is similar to *L. metallicum* from Curtis Island and parts of western Tasmania but differs from those found elsewhere in Bass Strait (pers. com. Peter Rawlinson).

INVERTEBRATES

The following invertebrates were collected and preserved for the collections of the Queen Victoria Museum.

ARCHAEOGNATHA (Rockjumpers). Several specimens were collected when they jumped from crevices in overhanging rocks.

ODONATA (Dragonflies). One large specimen collected.

BLATTODEA (Cockroaches). Two specimens of one species were collected.

FORMICIDAE (Ants). One medium size colonial species of ant was found beneath stones over most of the island.

DERMAPTERA (Earwigs). A number of specimens were collected from all over the island.

ORTHOPTERA (Crickets). One mole cricket (GRYLLOTALPIDAE) was collected after having been captured by a lizard. One field cricket (GRYLLIDAE) was also collected.

COLEOPTERA (Beetles). Four species were collected including a small click beetle (ELATERIDAE) and some larvae.

DIPTERA (Flies). Several species were observed but only one was collected.

LEPIDOPTERA (moths). Several species were observed but not collected. Larval cases of the moth family PSYCHIDAE were plentiful.

ARANEIDA (Spider). Two species of spiders were collected one of which belonged to the family DIPLURIDAE. This was common all over the island in silken lined holes in the ground. It was found to be nocturnally active some being collected at night on the walls of the tents. One member of the expedition was bitten, but without harmful effect.

SCORPIONIDAE (Scorpions). Three specimens of one species collected.

DECAPODA (Crabs). *Nectocarcinus tuberculosus*. Rough Rock-crab. Three were collected from between boulders in the bay at low tide.

Leptograpsus octodentatus Burrowing Shore-crab. Occurs commonly over most of the island, hiding by day in burrows or beneath stones or vegetation. It was found to be a nocturnally active scavenger.

ISOPODA Four species of terrestrial isopods were collected beneath stones and vegetation. These were *Ligia australiensis* Dana, 1853, *Deto marina* (Chilton, 1884), *Plymophiloscia ulverstonensis* Green, 1961 and *Cubaris tasmaniensis* Green, 1961. The last mentioned, of which only one female was collected, has been identified as an atypical example of this species.

Aquatic isopods belonging to the superfamily ASELLOTA were also collected.

AMPHIPODA. Three species of marine amphipods were collected along the shore line.

MOLLUSCA. Fifteen species were collected alive from the shore line. These were as follows:

AMPHINEURA
Sypharochiton pellis-serpentis (Quoy & Gaimard, 1835)
GASTROPODA
Austrocochlea concamerata (Wood, 1828)
Subninella undulata (Solander, 1786)
Melanerita melanotragus (Smith, 1884)
Cominella lineolata (Larmarck, 1809)

Lepsiella vinosa (Lamarck, 1822)
Dicathais textilosa (Lamarck, 1822)
Siphonaria diemenensis Quoy & Gaimard, 1833
Chiazacmea flammea (Quoy & Gaimard, 1834)
Patelloida latristrigate (Angas, 1865)
Cellana solida (Blainville, 1825)
Patellanax peroni (Blainville, 1825)
BIVALVAVIA
Electroma georgiana (Quoy & Gaimard, 1835)
Xenostrobus pulex Lamarck, 1819)
Brachidontes rostratus (Dunker, 1856)

COELENTERATA. Two specimens of one species of anemone were collected from a rock pool.

ECHINODERMATA. Four specimens of the sea star *Patiriella exigua* were collected from a rock pool.

ECTOPARASITIC FAUNA

Because of their special interest and association the ectoparasites are listed separately.

MITES

Haemolaelaps fahrenholzi from *Pachyptila turtur.*

TICKS

Ixodes eudyptidis from *Diomedea cauta* This tick was extremely prevalent, being present in hundreds in the nests beneath the young and fastened to the bare skin beneath their bills and to a lesser extent, on the feet. Ticks collected from the necks of *D. cauta* on Albatross Island in 1960 were determined as *I. auritulus* (Macdonald & Green 1963). No *I. auritulus* was found in the 1973 samples nor was *I. eudyptidis* found in the 1960 sample.

I. kohlsi from *Eudyptula minor.*

LICE

Harrisoniella sp. from *Diomedea cauta.*

Perineus sp. (Prob. *P. circumfasciatus*) from *Diomedea cauta.*

FLEAS

Parapsyllus australiacus from *Pachyptila turtur* and also from *Diomedea cauta.* This flea was extremely prevalent in the nests of *D. cauta.*

Parapsyllus taylori from *Pachyptila turtur.*

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A CATALOGUE OF THE TYPE MATERIAL IN THE QUEEN VICTORIA MUSEUM, LAUNCESTON

by

R. H. GREEN
QUEEN VICTORIA MUSEUM

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INTRODUCTION

The role filled by the Queen Victoria Museum cannot be directly related to any other such institution in Australia. It was built by the State Government and opened in 1891 as a second State Museum to serve the northern part of the island of Tasmania. For four years, the Curator of the Tasmanian Museum attempted to supervise both museums by making monthly visits to Launceston but it was soon found that this arrangement was inadequate. Accordingly, in 1895 the State Government transferred the Museum building, contents and land to the Launceston City Council in trust with the assurance of an annual grant from the Consolidated Revenue Fund and the arrangment still continues today.

This catalogue is arranged to list the type specimens which have been lodged with the Queen Victoria Museum. Following the classification the relevant reference is given, then the type, its registered numbers (old catalogue, new catalogue and Queen Victoria Museum type number) and the method of preservation, followed by the collection data and any relevant notes.

Phylum CHORDATA
Class MAMMALIA
Order PINNIPEDIA
Family OTARIIDAE
Genus *Arctocephalus* F. Cuvier, 1824

Arctocephalus tasmanicus Scott & Lord, 1926

Pap. Proc. Roy. Soc. Tas. 1926 (1925): 189, pl. 18, 19
Cotype 4, 1957/1/20, Q.V.M. type 98, skull.
Cotype 5, 1957/1/12, Q.V.M. type 99, "
Cotype 7, 1971/1/8, Q.V.M. type 109, "

Cotype 8, 1957/1/13, Q.V.M. type 100, skull
Cotype 10, 1957/1/11, Q.V.M. type 101, "
Collected from Cooee, Tamar River Heads and other localities on the north coast of Tasmania.

Class AMPHIBIA
Order ANURA
Family HYLIDAE
Genus *Hyla* Laurenti, 1768

Hyla burrowsi Scott, 1942

Rec. Queen Vict. Mus. 1(1):7, pl. 1, 2, 3.
Allotype female, 1941/40, 1971/4/3, Q.V.M. type 89, spirit specimen
Found clinging to Button grass *Gymnoschoenus sphaerocephalus* Bentham, on the edge of a small pond near Dove Lake, Cradle Valley, Tasmania, altitude 3100 feet on 7 January 1941.
Note This specimen was originally preserved in spirit but has dried out and now only the desiccated skeleton remains. The Holotype male 1941/41 and the Paratype female 1941/42, quoted by Scott as being lodged in this Museum, are missing.

Hyla aurea major Copland, 1957

Proc. Linn. Soc. N.S.W. 82: 79.
Holotype, 1939/120, 1960/4/2, Q.V.M. type 111, spirit specimen
Collected at Collins Cap, Tasmania on 29 September 1939.

Phylum PISCES
Class ELASMOBRANCHII
Order LAMNIFORMES
Family ORECTOLOBIDAE
Genus *Parascyllium* Gill, 1862

Parascyllium multimaculatum Scott, 1935

Pap. Proc. Roy. Soc. Tas. 1935 (1934): 63, pl. 5, fig.1.
Holotype Male, H. T. 983, study mount
Secured from the Tamar River Heads, Northern Tasmania by Mr. C. Andrews and mounted and presented to this Museum by Mr. G. R. F. Green.
Note This specimen is missing.

Class TELEOSTOMI
Order GALAXIIFORMES
Family GALAXIIDAE
Genus *Galaxias* Cuvier, 1816

Galaxias cleaveri Scott, 1934

Pap. Proc. Roy. Soc. Tas. 1934 (1933):41, pl. 6.
Holotype, H. T. 938.
Collected from inside a piece of eucalypt root at West Ulverstone, North-West Tasmania on 8 January, 1933.
Note This specimen is missing.

Galaxias johnstoni Scott, 1936

Pap. Proc. Roy. Soc. Tas. 1936 (1935): 92, fig. 1.
Holotype, H. T. 948, 1971/5/16, Q.V.M. type 70, spirit specimen.
Paratypes, 1971/5/17, Q.V.M. type 71, 2 spirit specimens.
Collected from a creek crossing the Hobart - Queenstown road about three and three quarter miles westwards from the Nive Bridge, Tasmania on 31 March, 1934.

Galaxias scopus Scott, 1936

Pap. Proc. Roy. Soc. Tas. 1936 (1935): 95, fig. 2.
Holotype, H. T. 949, 1971/5/18, Q.V.M. type 67, spirit specimen

Collected from a small brackish-water stream on Clarke Island, Bass Strait on 18 January 1935.

Galaxias parkeri Scott, 1936

Pap. Proc. Roy. Soc. Tas. 1936 (1935): 99, fig. 3.
Paratypes, P. T. 950, a-b, 1971/5/20, Q.V.M. type 74, 2 spirit specimens
Paratype, 1971/5/21, Q.V.M. type 75, 1 spirit specimen.
Paratype, 1971/5/22, Q.V.M. type 76, 1 spirit specimen.
Paratype, 1971/5/23, Q.V.M. type 77, 2 spirit specimens.
Collected at and near to Reynold's Neck, Great Lake, Tasmania on 17 and 19 February, 1935.

Galaxias upcheri Scott, 1942

Rec. Queen Vict. Mus. I (1): 51, pl. 10.
Holotype, 1940/361/1, spirit specimen.
Paratypes, 1971/5/24, Q.V.M. type 72, 3 spirit specimens.
Paratypes, 1971/5/25, Q.V.M. type 73, 3 spirit specimens.
All collected in swampy country at Dover, Southern Tasmania on 15 March, 1936.
Note The Holotype is missing.

Genus *Brachygalaxias* Eigenmann, 1928

Brachygalaxias pusillus flindersiensis Scott, 1971

Rec. Queen Vict. Mus. 37: 6.
Holotype, 1969/5/25a, Q.V.M. type 173, spirit specimen.
Paratypes, 1969/5/25b, Q.V.M. type 174, 14 spirit specimens.
All collected from a stream at Lackrana, Flinders Island, Bass Strait.

Brachygalaxias pusillus tasmaniensis Scott, 1971

Rec. Queen Vict. Mus. 37: 3.
Holotype, 1971/5/48a, Q.V.M. type 175, spirit specimen.
Paratypes, 1971/5/48b, Q.V.M. type 176, 11 spirit specimens.
All collected from a soak from a dam at "Marengo", Waterhouse, Tasmania.
Note Scott mistakenly quoted the registered number of the holotype as 1970/5/25a.

Genus *Saxilaga* Scott, 1936

Saxilaga anguilliformis Scott, 1936

Pap. Proc. Roy. Soc. Tas. 1936 (1935): 106, fig. 4.
Holotype, H. T. 951, 1971/5/26, Q.V.M. type 80, spirit specimen.
Caught on hook and line in Cox's Creek, which runs into the Inglis River at Wynyard, North-west Tasmania on 11 December, 1934.

Genus *Paragalaxias* Scott, 1935

Paragalaxias shannonensis Scott, 1935

Pap. Proc. Roy. Soc. Tas. 1935 (1934): 41, pl. 3, text fig.1, 2.
Holotype, H. T. 939a.
Paratype, P. T. 939b.
Paratypic material on slides, P.T. sl. 939, c to n.
Collected from small beds of water-weed in the Shannon River, Mienna, Tasmania on 3 December 1933 and between 29 March and 2 April 1934.
Note All this material is missing. An additional 13 specimens used in the description are present.

Class TELEOSTOMI
Order ANGUILLIFORMES
Family MURAENIDAE
Genus *Gymnothorax* Bloch, 1795

Gymnothorax leecote Scott, 1965

Pap. Proc. Roy. Soc. Tas. 99: 54, fig. 1.
Holotype, 1964/5/15, Q.V.M. type 123, spirit specimen.
Captured in a crayfish pot set in ten fathoms off Georges Rock, north of St. Helens Tasmania in July, 1963.

Order LAMPRIDIFORMES
Family AGROSTICHTHYIDAE
Genus *Agrostichthys* Phillips, 1924

Agrostichthys benhami Scott, 1934

Pap. Proc. Roy. Soc. Tas. 1934 (1933): 47, pl. 7, 8, text fig. 2.
Holotype, H. T. 906, 1971/5/27, Q.V.M. type 86, spirit specimen.
Collected at Ulverstone, North-west Tasmania on 14 February 1908.

Order SYNGNATHIFORMES
Family SYNGNATHIDAE
Genus *Syngnathus* Linnaeus, 1758

Syngnathus tuckeri Scott, 1942

Rec. Queen Vict. Mus. I (1): 17, pl.5.
Holotype male, 1941/16, 1971/5/28, Q.V.M. type 66, spirit specimen.
Collected by netting in shallow water at Bridport, Northern Tasmania. on 11 January, 1941.

Syngnathus mollisoni Scott, 1955

Pap. Proc. Roy. Soc. Tas. 89: 131, pl.1, fig. 2.
Holotype, 1954/5/2.
Collected when found fastened to a hand line while fishing on a clean sandy bottom in 25 fathoms off Bivouac Bay, Tasman Peninsula, South-east Tasmania on 29 March 195
Note This specimen is missing.

Order PERCIFORMES
Family PATAECIDAE
Genus *Pataecus* Richardson, 1844

Pataecus armatus Johnson, 1891

Pap. Proc. Roy. Soc. Tas. 1936 (1935): 125, fig. 3.
Neotype , 891, 1971/5/29, Q.V.M. type 84, spirit specimen.
Collected from Northern Tasmanian waters.

Family KYPHOSIDAE
Genus *Kyphosus* Lacèpede, 1802

Kyphosus diemenensis Scott, 1972

Pap. Proc. Roy. Soc. Tas. 105: 135, fig. 1.
Holotype, 1967/5/26, Q.V.M. type 179, spirit specimen.
Collected off the coast of northern Tasmania in January, 1967.

Family NANNOPERCIDAE
Genus *Nannoperca* Günther, 1861

Nannoperca australis flindersi Scott, 1971

Pap. Proc. Roy. Soc. Tas. 105:126.

Holotype, 1970/5/25a, Q.V.M. type 177, spirit specimen.
Paratype, 1970/5/25b, Q.V.M. type 178, spirit specimen.
All collected from a drain at Lackrana, Flinders Island, Bass Strait.

Family GOBIIDAE
Genus *Tasmanogobius* Scott, 1935

Tasmanogobius lordi Scott, 1935

Pap. Proc. Roy. Soc. Tas. 1935(1934): 56, pl.4, fig. 2, text fig.1, 2.
Holotype, H. T. 941a, 1971/5/30, Q.V.M. type 78, spirit specimen.
Paratype, P. T. 941b, 1971/5/31, Q.V.M. type 79, spirit specimen.
Paratypic material on slides, P.T. sl. 941, c-g.
Collected at the mouth of the Leven River, West Ulverstone, Tasmania on 9 August, 1934.
Note The paratypic material on slides is missing.

Family OPHIDIIDAE
Genus *Ophiclinus* Castlenau, 1872

Ophiclinus greeni Scott, 1935

Pap. Proc. Roy. Soc. Tas. 1935 (1934): 114, fig. 1.
Holotype, H. T. 805.
Collected at Lady Lucy Beach, Low Head, Northern Tasmania on 17 January, 1934.
Note This specimen is missing.

Genus *Breona* Scott, 1967

Breona greeni Scott, 1967

Pap. Proc. Roy. Soc. Tas. 101: 211, fig. 3.
Holotype female, 1966/5/10, Q.V.M. type 136, spirit specimen.
Paratype female, 1966/5/11, Q.V.M. type 137, spirit specimen.
Paratype male, 1966/5/12, Q.V.M. type 138, spirit specimen.
Collected from tidal pools at Green's Beach, Tamar River, Tasmania on 4 May 1966 (holotype) and 19 December 1965 (paratype).

Family CLINIDAE
Genus *Clinus* Cuvier, 1816

Clinus puellarum Scott, 1955

Pap. Proc. Roy. Soc. Tas. 89: 139, pl.1, fig. 1.
Holotype, 1954/5/1.
Collected in a rock pool at East Beach, Low Head, Northern Tasmania on 21 February, 1952.
Note This specimen is missing.

Phylum ARTHROPODA
Class ARACHNIDA
Order ARANEIDA
Family CTENIZIDAE
Genus *Aganippe* O. P. Cambridge, 1877

Aganippe tasmanica Hickman, 1928

Pap. Proc. Roy. Soc. Tas. 1928 (1927): 158, pl.21, fig. 1, pl.22, fig. 2, 3, text fig. 1.
Holotype female, 1957/13/21, Q.V.M. type 32, spirit specimen.
Collected at Prince of Wales Bay, Derwent Park, Hobart, Tasmania on 29 April, 1927.

Genus *Arbanitis* L. Koch, 1873

Arbanitis scaurus Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1927 (1926): 57, pl.5, fig. 3, 4, text fig. 4, 5, 6, 7.
Holotype male, 1957/13/12, Q.V.M. type 24, spirit specimen.
Holotype female, 1957/13/13, Q.V.M. type 25, spirit specimen.
Collected at Westmoreland Falls, Mole Creek, Tasmania on 5 April, 1926.

Arbinitis mestoni Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1928 (1927): 162, pl.23, fig. 4, 5, text fig. 2, 3, 4, 5.
Holotype male, 1957/13/14, Q.V.M. type 26, spirit specimen.
Holotype female, 1957.13.15, Q.V.M. type 27, spirit specimen.
Collected at Woodsdale, Tasmania on 24 April, 1927.

Family DIPLURIDAE
Genus *Hexathele* Ausserer, 1871

Hexathele montanus Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1927 (1926): 73, pl.8, fig. 9, 10, pl.9, fig. 11, text fig. 13, 14, 15, 16.
Holotype male, 1957/13/5, Q.V.M. type 16, spirit specimen.
Holotype female, 1957/13/4, Q.V.M. type 15, spirit specimen.
Collected at Higgs Track, Western Tiers, Chudleigh, Tasmania on 2 April, 1926.

Genus *Aname* L. Koch, 1873

Aname pexa Hickman, 1930

Pap. Proc. Roy. Soc. Tas. 1930 (1929): 87, pl.19, fig.1, 2, text fig. 1, 2, 3, 4, 5, 6.
Holotype male, 1957/13/18, Q.V.M.type 30, spirit specimen.
Holotype female, 1957/13/19, Q.V.M. type 31, spirit specimen.
The male was collected at Prince of Wales Bay, Derwent Park, Tasmania, on 21 May 1923 and the female from the same area on 17 May, 1929.

Genus *Atrax* O. P. Cambridge, 1877

Atrax venenatus Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1927 (1926): 63, pl.6, fig. 5, 6, text fig. 8, 9, 10, 11.
Holotype male, 1957/13/16, Q.V.M. type 28, spirit specimen.
Holotype female, 1957/13/17, Q.V.M. type 29, spirit specimen.
Collected at New Town Creek, Hobart, Tasmania on 22 December, 1925.

Atrax pulvinator Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1927 (1926): 70, pl.7, fig. 7, 8, text fig. 12.
Holotype female, 1957/13/20, Q.V.M. type 17, spirit specimen.
Collected at Cascades, Hobart, Tasmania on 25 December, 1925.

Family MIGIDAE
Genus *Migas* L. Koch, 1873

Migas nitens Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1927 (1926): 52, pl.4, fig.1, 2, text fig. 1, 2, 3.

Holotype male, 1957/13/23, Q.V.M. type 34, spirit specimen.
Holotype female, 1957/13/22, Q.V.M. type 33, spirit specimen.
Collected at Prince of Wales Bay, Derwent Park, Tasmania and Cornelian Bay, New Town, Tasmania, respectively on 30 December, 1925.

Family DYSDERIDAE
Genus *Ariadna* Audouin, 1826 *in* Savigny

Ariadna major Hickman, 1929

Pap. Proc. Roy. Soc. Tas. 1929 (1928): 100, fig. 2.
Holotype female, 1957/13/30, Q.V.M. type 41, spirit specimen.
Collected on the summit of Mt. Hobbs (2,400 feet), Woodsdale, Tasmania on 13 May,1928.

Ariadna muscosa Hickman, 1929

Pap. Proc. Roy. Soc. Tas. 1929 (1928): 103, fig. 3.
Holotype male and female, 1957/13/26, Q.V.M. type 27, spirit specimen.
Collected in the Punchbowl Reserve, Launceston, Tasmania on 17 May, 1928.

Family THERIDIIDAE
Genus *Ariamnes* Thorell, 1870

Ariamnes patersoniensis Hickman, 1927

Pap. Proc. Roy. Soc. Tas. 1927 (1926): 79, pl.10, fig. 12, 13.
Holotype female, 1957/13/27, Q.V.M. type 38, spirit specimen.
Collected from near the Launceston Water Purification Plant at Patersonia, Tasmania on 29 January, 1926.

Family MIMETIDAE
Genus *Mimetus* Hentz, 1831

Mimetus audax Hickman, 1929

Pap. Proc. Roy. Soc. Tas. 1929 (1928): 107, pl.17, text fig. 4, 5,
Holotype female, 1957/13/25, Q.V.M. type 36, spirit specimen.
Collected in Brougham Street, Launceston, Tasmania on 25 April, 1928.

Mimetus auriocultatus Hickman, 1929

Pap. Proc. Roy. Soc. Tas. 1929 (1928): 110, fig. 6, 7.
Holotype male and female, 1957/13/24, Q.V.M. type 35, spirit specimen.
Collected at Punchbowl, Launceston, Tasmania on 5 May, 1928.

Genus *Ero* C. Koch, 1835

Ero tasmaniensis Hickman, 1929

Pap. Proc. Roy. Soc. Tas. 1929 (1928): 114, fig. 8.
Holotype male and female, 1957/13/28, Q.V.M. type 39, spirit specimens.
Collected at Trevallyn, Launceston, Tasmania, April 1928 (male), August 1928 (female).

Family CLUBIONIDAE
Genus *Miturga* Thorell, 1870

Miturga albopunctata Hickman, 1930

Pap. Proc. Roy. Soc. Tas. 1930 (1929): 105, pl.23, fig. 8, 9, text fig. 13, 14.
Holotype female, 1957/13/11, Q.V.M. type 23, spirit specimen.

Collected at Daisy Dell, (620m) on the road to Cradle Mountain, Tasmania in December, 1927.

Miturga splendens Hickman, 1930

Pap. Proc. Roy. Soc. Tas. 1930 (1929): 109, pl.24, fig. 10, 11, text fig. 15, 16.
Holotype female, 1957/13/10, Q.V.M. type 22, spirit specimen.
Collected at the Quoin (460m), Ross, Tasmania on 6 November, 1927.

Miturga velox Hickman, 1930

Pap. Proc.Roy. Soc. Tas. 1930 (1929): 114, pl.25, fig. 12, 13, pl.26, fig. 14, 15, text fig. 17, 18, 19.
Holotype male, 1957/13/9, Q.V.M. type 21, spirit specimen.
Holotype female, 1957/13/8, Q.V.M. type 20, spirit specimen.
The male was collected at Trevallyn, Launceston Tasmania on 4 September, 1929 and the females at Punchbowl, Launceston on 19 November, 1927.

Family OONOPIDAE
Genus *Tasmanoonops* Hickman, 1930

Tasmanoonops alipes Hickman, 1930

Pap. Proc. Roy. Soc. Tas. 1930 (1929): 98 pl.20, fig. 3, 4, text fig. 7, 8, 9, 10, 11, 12.
Holotype female, 1957/13/34, Q.V.M. type 45, spirit specimen.
Collected at Mount Hobbs, Woodsdale, Tasmania on 13 May, 1928.

Pap. Proc. Roy. Soc. Tas. 1932 (1931):20, fig. 1, 2.
Holotype male, 1957/13/33, Q.V.M. type 44, spirit specimen.
Collected at Great Lake, (1000m) on 15 March, 1930.

Genus *Oonopinus* Simon, 1882

Oonopinus mollipes Hickman, 1932

Pap. Proc. Roy. Soc. Tas. 1932 (1931): 23 fig 3, 4, 5.
Holotype female, 1957/13/32, Q.V.M. type 43, spirit specimen.
Collected at Trevallyn, Launceston, Tasmania on 27 May, 1930.

Genus *Orchestina* Simon, 1882

Orchestina launcestoniensis Hickman, 1932

Pap. Proc. Roy. Soc. Tas. 1932 (1931): 26, fig. 6, 7, 8, 9, 10, 11.
Holotype male and female, 1957/13/29, Q.V.M. type 40, spirit specimen.
Collected at Punchbowl, Launceston, Tasmania on 24 May, 1930.

Family AVICULARIDAE
Genus *Chenistonia* Hogg, 1901

Chenistonia trevallynia Hickman, 1926

Pap. Proc. Roy. Soc. Tas. 1926 (1925): 171, pl.12, 13, text fig. 1, 2, 3, 4.
Holotype male, 1957/13/7, Q.V.M. type 19, spirit specimen.
Holotype female, 1957/13/6, Q.V.M. type 18, spirit specimen.
Collected at Trevallyn, Launceston, Tasmania on 11 September, 1925.

Family SYMPHYTOGNATHIDAE
Genus *Symphytognaltra*

Symphytognaltra globosa Hickman, 1931

Proc. Zool.Soc. Lond. 1931 (4): 1322, pl.1, text fig. 1, 2, 3, 4, 5, 6.
Holotype male, 1957/13/31, Q.V.M. tvpe 42, spirit specimen.
Holotype female, 1957/13/35, Q.V.M. tvpe 46, spirit specimen.
Collected in grass tussocks at Punchbowl, Launceston, Tasmania on 30 June, 1930.

Order ACARI
Family ARGASIDAE
Genus *Argas* Latreille, 1796

Argas (Carios) dewae Kaiser & Hoogstraal, 1973

Allotvpe female, HH20-300, 1973/13/1, Q.V.M. type 191, spirit specimen.
Collected from the roost of *Eptesicus pumilus* at Kelso, Tasmania on 9 January, 1965.

Paratype male HH20-395, 1973/13/2, Q.V.M. type 192, spirit specimen.
Collected in a hut at Brighton, Victoria in March 1965.

Paratvpe larva HH20-298, 1973/13/3, Q.V.M. type 193, spirit specimen.
From *Eptesicus pumilus* collected beneath the bark of *Eucalyptus* sp. at Epping Forest, Tasmania on 14 September 1965.

Class INSECTA
Order EMBIOPTERA
Family OLIGOTOMIDAE
Genus *Notoligotoma* Davis, 1936

Notoligotoma nitens Davis, 1936

Proc. Linn. Soc. N.S.W. 61: 246, fig. 9, 16, 23, 30, 37, 39, 40, 41.
Paratype female, 1957/12/184, Q.V.M. type 90, spirit specimen.
Paratype female, 1957/12/193, Q.V.M. type 93, spirit specimen.
Collected from beneath the bark of *Eucalyptus peripeta* at Sylvania, New South Wales, on 11 August, 1935.

Paratype male, 1957/12/194, Q.V.M. type 92, spirit specimen.
Collected in *Polypodum confluens* at Myall Lakes, New South Wales, on 24 August, 1934.

Genus *Metoligotoma* Davis, 1936

Metoligotoma reducta Davis, 1936

Proc. Linn. Soc. N.S.W. 61: 248, fig. 10, 17, 24, 31, 38, 42, 43.
Paratvpe male, 1957/12/185, Q.V.M. type 94, spirit specimen.
Paratype male, 1957/12/191, Q.V.M. type 95, spirit specimen.
Collected from among fallen *Casuarina* sp. needles at Narrabeen, New South Wales, on 16 September, 1934.

Metoligotoma pentanesiana Davis, 1936

Proc. Linn. Soc. N.S.W. 61:254, fig. 1, 2, 4, 6.
Paratype male, 1957/12/189, Q.V.M. tvpe 96, spirit specimen.
Paratype female, 1957/12/192, Q.V.M. type 91, spirit specimen.
Collected from galleries under stones at Five Islands, New South Wales on 13 September, 1936.

Order PHTHIRAPTERA
Family MENOPONIDAE
Genus *Myrsidea* Waterston, 1915

Myrsidea australiensis australiensis Klockenhoff, 1971

Bonn. Zool. Beitr. 22: 297, fig. 1, 2, 3.
Paratype male and female, 1972/12/1, Q.V.M. type 182, mounted on glass slide.
Paratype male, 1972/12/2, Q.V.M. type 183, mounted on glass slide.
Paratype female, 1972/12/3, Q.V.M. type 184, mounted on glass slide.
All taken from *Corvus tasmanicus* collected at Antill Ponds, Tasmania.

Myrsidea australiensis bennetti Klockenhoff, 1971

Bonn. Zool. Beitr. 22: 297, fig. 1, 2, 3.
Paratype male and female, 1972/12/4, Q.V.M. type 185, mounted on glass slide.
Taken from *Corvus bennetti* collected south-east of Geraldton, West Australia.

Family PHILOPTERIDAE
Genus *Rallicola* Johnston & Harrison, 1911

Rallicola mortieri Emerson, 1964

J. Ent. Soc. Qld. 3: 30, fig. 4, 5.
Paratype, 1965/12/11, Q.V.M. type 180, mounted on glass slide.
Taken from *Tribonyx mortieri* collected at Diprose Lagoon, Tasmania.

Rallicola campbelli Emerson, 1964

J. Ent. Soc. Qld. 3: 30, fig. 1, 2, 3.
Paratype, 1965/12/12, Q.V.M. type 181, mounted on glass slide.
Taken from *Tribonyx mortieri* collected at Diprose Lagoon, Tasmania.

Class CRUSTACEA
Order ANASPIDACEA
Family SYNCARIDA
Genus *Allanaspides* Swain, Wilson, Hickman and Ong, 1970

Allanaspides helonomus Swain, Wilson, Hickman & Ong, 1970

Rec. Queen Vict. Mus. 35: 1, pl.1, 2, text fig. 1 to 23.
Paratype males, 1970/10/2, Q.V.M. type 144, 2 spirit specimens.
Paratype females, 1970/10/3, Q.V.M. type 145, 2 spirit specimens.
Collected from buttongrass plains near Lake Pedder, Tasmania on 25-26 November, 1969.

Allanaspides hickmani

Crustaceana 21(2): 196, fig. 1 to 10.
Paratype males, 1970/10/4, Q.V.M. type 146, 2 spirit specimens.
Paratype females, 1970/10/5, Q.V.M. type 147, 2 spirit specimens.
Collected from buttongrass plains near Lake Pedder, Tasmania on 8 January, 1970.

Phylum MOLLUSCA
Class GASTROPODA
Order PECTINIBRANCHIA
Family PALUDESTRINIDAE
Genus *Hydrobia* Hartmann, 1821

Hydrobia turbinata Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 77, pl.2, fig. 3.
Holotype, 1957/9/8, Q.V.M. type 54, 12 dry shells collected from Styx

River, near Falmouth, Tasmania.

Genus *Potamopyrgus* Stimpson, 1865

Potamophyrgus brownii Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 72, pl.3, fig. 14.
Holotype, 1957/9/6, Q.V.M. type 52, 5 dry shells.
Collected from St. Pauls River, near Avoca, Tasmania.

Potamopyrgus dyeriana Petterd, 1879

Jour. of Conch., 2: 86.
Holotype, 1957/9/15, Q.V.M. type 61, 3 dry shells.
Collected from a fresh water creek at Long Bay, D'Entrecastreaux Channel, Tasmania.

Potamopyrgus smithii Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 72, pl.1, fig. 10.
Holotype, 1957/9/14, Q.V.M. type 60, 15 dry shells.
Collected from a tributary of the Heazlewood River, North-west Tasmania.

Genus *Bythynia* Gray,1821

Bythynia dunrobinensis Tenison-Woods, 1876

Pap. Proc. Roy. Soc. Tas. 1876 (1875): 77.
Paratypes, 1971/9/1, Q.V.M. type 149, 2 dry shells.
Collected near Dunrobin, Ouse, Tasmania.

Genus *Beddomeia* Iredale, 1943

Beddomeia bellii Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 75, pl.1, fig. 7.
Holotype, 1957/9/11, Q.V.M. type 57, 3 dry shells.
Collected from a stream near Heazlewood River, North-west Tasmania.

Boddomeia lodderae Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 75, pl.3, fig. 1.
Holotype, 1957/9/9, Q.V.M. type 55, 2 dry shells.
Collected from Deep Creek, Duck River, North-west Tasmania.

Beddomeia hullii Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 76, pl.1, fig. 8.
Holotype, 1957/9/5, Q.V.M. type 51, 3 dry shells.
Collected from a tributary of the Heazlewood River, North-west Tasmania.

Order MESOGASTROPODA
Family STILIFERIDAE
Genus *Stilifera* Broderip, 1832

Stilifer lodderae Petterd, 1884

Jour. of Conch. 4: 140.
Holotype, 1957/9/2, Q.V.M. type 48, 1 dry shell.
Collected from Leven River Heads, Tasmania.

Stilifer petterdi Tate & May, 1900

Trans. Proc. Roy. Soc. S. Aust. 24: 96.

Holotype, 1957/9/1, Q.V.M. type 47, 1 dry shell.
Collected from Leven River Heads, North-West Tasmania.

Family PTEROTRACHEIDAE
Genus *Pterotrachea* Cuvier, 1817

Pterotrachea kingicola van Gooch, 1942

Rec. Queen Vict. Mus. 1 (1): 59, pl.11, 12.
Holotype male, 1940/254, 1971/9/2, Q.V.M. type 65, spirit specimen.
Caught in a crayfish pot at 28 fathoms near King Island, Bass Strait, Tasmania and received at the Queen Victoria Museum on 18 June, 1940.

Order PULMONATA
Family LYMNAEIDAE
Genus *Limnaea* Lamarck, 1799

Limnaea huonensis Tenison-Woods, 1876

Pap. Proc. Roy. Soc. Tas. 1876 (1875): 71
Holotype, 1957/9/3, Q.V.M. type 49, 1 dry shell
Habitat, Huon River, upper part, Craycroft River etc.

Lymnaea neglecta Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 66, pl.2, fig. 13
Holotype, 1957/9/10, Q.V.M. type 56, 3 dry shells.
Collected from a tea-tree swamp at Launceston,Tasmania.

Lymnaea lutosa Petterd, 1889

Pap. Proc. Roy. Soc. Tas. 1889 (1888): 67, pl.2, fig. 13.
Holotype, 1957/9/12, Q.V.M. type 58, 1 dry shell.
Collected from Jordan River, Brighton, Tasmania.

Family PLANORBIDAE
Genus *Planorbis* Guettard, 1756

Planorbis meridionalis Brazier, 1875

Proc. Lin. Soc. N.S.W. 1875: 20.
Holotype, 1957/9/13, Q.V.M. type 59, 2 dry shells.
The Locality given is Ouse River and Circular Head, Tasmania

Family FERRISSIDAE (ANCYLIDAE)
Genus *Ancylus* Geoffrey, 1767

Ancylus mariae Petterd, 1902

Pap. Proc. Roy. Soc. Tas. 1902 (1900-1901): 1.
Holotype, 1957/9/4, Q.V.M. type 50, 2 dry shells.
Collected at Maria Island, Southern Tasmania.

Ancylus irvinae Petterd, 1888

Pap. Proc. Roy. Soc. Tas. 1888 (1887): 40, pl.44.
Holotype, 1957/9/7, Q.V.M. type 53, 2 dry shells
Collected from Great Lake, Tasmania.

Family CHAROPIDAE
Genus *Helix* Linnaeus, 1758

Helix kingstonensis Legrand, 1871

Coll.Mon. Tas. Land Shells first edit., spec. no.40, pl.2, fig. 5
Cotypes, 1971/9/3, Q.V.M. type 143, 2 dry shells.
Collected at Browns River, Southern Tasmania.

Family PARYPHANTIDAE

Helix nelsonensis Brazier, 1871

Proc. Zool. Soc. 1871 (1870): 664
Holotype, 1971/9/4, Q.V.M. type 142, 1 dry shell.
Collected at Hobart, Tasmania.

Family FLAMMULINIDAE
Genus *Helix* Linnaeus, 1758

Helix DuCani Legrand, 1871

Coll. Mon. Tas. Land Shells, first edit. spec. no. 56
Cotypes, 1971/9/6, Q.V.M. type 148, 2 dry shells.
Collected from Leven River, Tasmania.

Family ENDODONTIDAE
Genus *Helix* Linnaeus, 1758

Helix discors Petterd, 1902

Pap. Proc. Roy. Soc. Tas. 1902 (1900-1901):2
Holotype, 1957/9/16, Q.V.M. type 62, dry shell.
Collected on Maria Island, South-east Tasmania.

Order NUDIBRANCHIATA
Family DORIDIDAE
Genus *Aphelodoris* Bergh, 1879

Aphelodoris greeni Burn, 1966

Rec. S. A. Mus. 15, (2): 342, fig. 15, 16, 17.
Holotype, 1965/9/3, Q.V.M. type 133, spirit specimen.
Paratype, 1965/9/2, Q.V.M. type 134, spirit specimen.
Paratype, 1965/9/1, Q.V.M. type 135, spirit specimen.
Collected from rockpools at low tide between Greens Beach and Kelso, Tamar River, Tasmania on 30 October, 1965, 11 September 1965 and January 1964 respectively.

Phylum MULLUSCOIDA
Class BRACHIOPODA
Order ARTICULATA
Family TEREBRATULIDAE
Genus *Kraussina* Davidson, 1859

Kraussia atkinsoni Tenison-Woods, 1878

Pap. Proc. Roy. Soc. Tas. 1878 (1877): 57
Holotype, 1971/9/5, Q.V.M. type 110, 5 dry shells.
Collected by dredging in ten fathoms in Lond Bay, d'Entrecastreaux Channel, South Tasmania.

Phylum ANNULATA
Class HIRUDINEA
Order ARHYNCHOBDELLIDA
Family RICHARDSONIANIDAE
Genus *Priscabdella* Richardson, 1973

Priscabdella hickmani Richardson, 1973

Rec. Queen Vict. Mus. 47: 3, fig. 1.
Holotype, 1972/14/3, Q.V.M. type 190, spirit specimen.
Collected at Memana, Flinders Island, Bass Strait on 14 March 1966.

PALEONTOLOGY

Phylum CHORDATA
Class MAMMALIA
Order CETACEA
Family ZIPHIIDAE
Genus *Scaptodon* Chapman, 1917

Scaptodon lodderi Chapman, 1917

Proc. Roy. Soc. Vict. 30 (2) 1917 (1918): 150, pl.27.
Holotype, 1957/39/1, Q.V.M. type 1, 1 tooth.
Found washed up at Ulverstone, North-west Tasmania after a heavy gale.

Order MARSUPIALA
Family NOTOTHERIIDAE
Genus *Nototherium* Owen, 1871
Nototherium tasmanicum (Scott, 1911)

Tas. Nat. 2 (4): 64 fig. 1, 2, 3, 4, 5, Expanded in Vict. Mus. brochure No. 4 August 1912.
Holotype, 1965/39/2, Q.V.M. type 14, whole skeleton.
Collected from Mowbray Swamp, North-west Tasmania in July, 1910.

Order MONOTREMATA
Family ECHIDNIDAE
Genus *Zaglossus* Gill, 1877

Zaglossus harrissoni Scott & Lord, 1921

Pap. Proc. Roy. Soc. Tas. 1921 (1922): 13, pl. 5.
Holotype, 1965/39/5, Q.V.M. type 13, femur.
Collected from a swamp on King Island, Bass Strait, Tasmania.

Phylum MOLLUSCA
Class GASTROPODA
Order ARCHAEOGASTROPODA
Family SINNOPEIDAE
Genus *Keeneia* Etheridge, 1902

Keeneia twelvetreesi W. S. Dun, 1913

Tas. Dept. Mines Geo. Survey Record No. 1: 5, pl. 2
Holotype, 1957/38/342, Q.V.M. type 122, 1 specimen.
Collected from above Tasmanite shale horizon, Mersey Bend, North-west Tasmania.

Class CEPHALOPODA
Order ACTINOCERIDA
Family ARMENOCERATIDAE
Genus *Nybyoceras* Troedsson, 1926

Nybyoceras multicubiculatum Teichert & Glenister, 1953

Bull. Am. Paleont. 34 No. 144, pl.2, fig. 1, 2, 3.
Holotype, G.S.T. 850, 1957/38/129, Q.V.M. type 9, 2 pieces.
Paratype, G.S.T. 848, 1957/38/124, Q.V.M. type 10, 5 pieces.
Collected from a limestone quarry at Railton, Tasmania.

Nybyoceras paucicubiculatum Teichert & Glenister, 1953

Bull. Am. Paleont. 34 No. 144, pl.1, fig. 6, 7, 9.
Holotype, G.S.T. 849, 1957/38/125, Q.V.M. type 11, 2 pieces.
Holotype, G.S.T. 846, 1957/38/128, Q.V.M. type 11, 2 pieces.
Paratype (Hypotype) G.S.T. 846, 1957/38/128, Q.V.M. type 12, 1 piece.
Collected in limestone at Railton, Tasmania.

Family ORMOCERATIDAE
Genus *Ormoceras* Stokes, 1840

Ormoceras johnstoni Teichert & Glenister, 1953

Bull. Am. Paleont. 34 No. 144, pl.2, fig. 5.
Holotype, G.S.T. 847, 1957/38/127, Q.V.M. type 8, 9 pieces.
Collected at King Extended Hill, Zeehan, Tasmania.

Phylum GYMNOSPERMOPHYTA
Class CONIFEROPSIDA
Order CORDIATALES
Family CORDAITACEAE
Genus *Dadoxylon* Endlicher, 1847

Dadoxylon penmani Scott, 1933

Pap. Proc. Roy. Soc. Tas. 1933 (1934): 17.
Cotype, 1957/37/98, Q.V.M. type 2, 3 pieces.
Collected from an air shaft in the Aberfoyle Mine.

Class CYCADOPSIDA
Order CYCADALES
Genus *Cycadites* Sternberg, 1825

Cycadites dowlingi Scott, 1930

Pap. Proc. Roy. Soc. Tas. 1930 (1931): 91, fig. 1, 2, 3, 4, 5, 6.
Cotype 1, 1957/37/74, Q.V.M. type 112, 1 piece.
" 2, 1957/37/84, Q.V.M. type 113, 1 piece.
" 3, 1957/37/83, Q.V.M. type 114, 1 piece.
" 4, 1957/37/77, Q.V.M. type 115, 1 piece.
" 5, 1957/37/81, Q.V.M. type 116, 4 pieces.
" 6, 1957/37/87, Q.V.M. type 117, 2 pieces.
Collected from the Launceston Tertiary Basin formations at Harland's Rise, Evandale, Tasmania.

Order CONIFERALES
Family PODOCARPACEAE
Genus *Podocarpus* L. Heritier, 1807

Podocarpus brownei Selling, 1944

Svensk Bot. Tidskr. 44 (4): 558, pl.2, fig. 17, 18,19, Uppsala 1944.
Holotype, G.S.T. 964, 1960/37/7, Q.V.M. type 3, 1 piece.
Collected from "Paleogene" beds at Burnie, Tasmania.

LATUMCEPHALUM
(BOOPIDAE : PHTHIRAPTERA : INSECTA)

by

THERESA CLAY

BRITISH MUSEUM (NATURAL HISTORY)

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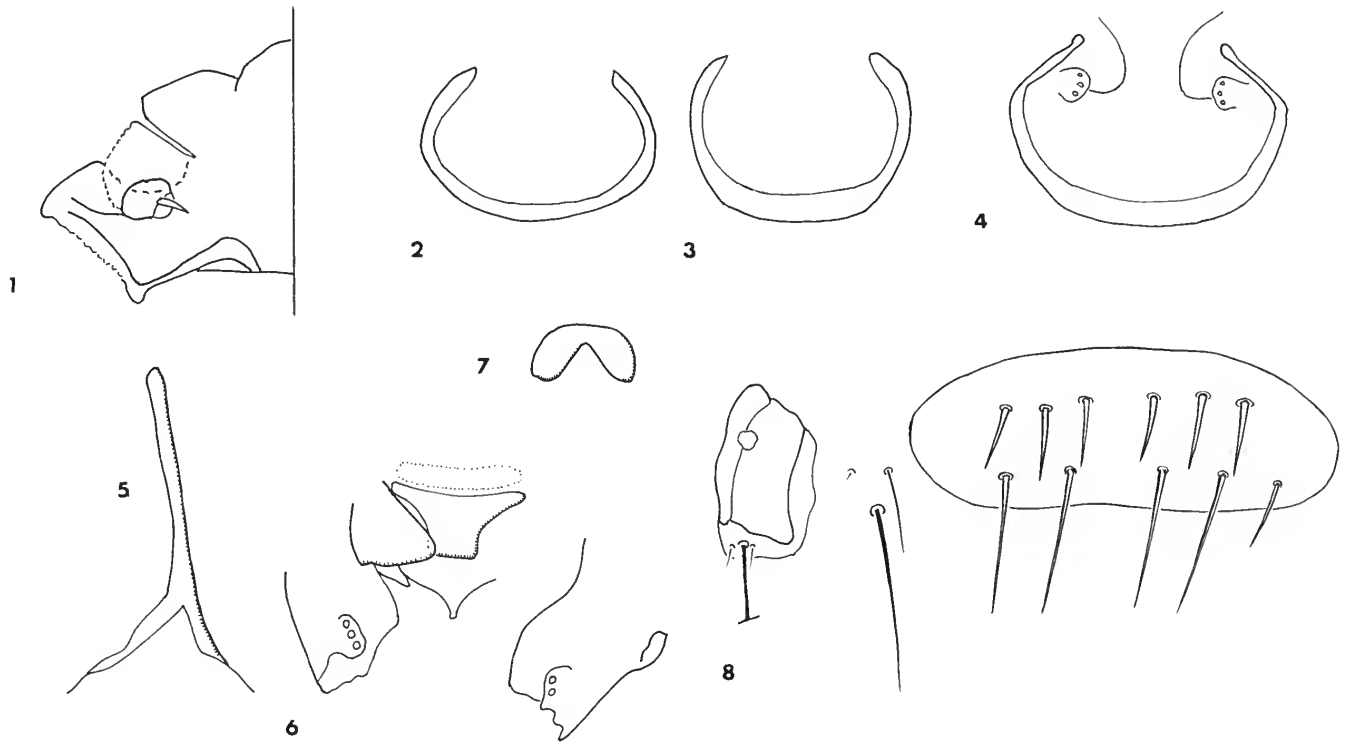

TEXT-FIGURES 1-8

Text-figs. 1, 4-8. *Latumcephalum greeni* sp. n. 1. Outline of half head. 2-4. Mesosome arch (sens. Kéler, 1971). 2. *L. lesouefi* Harrison & Johnston. 3. *L. macropus* Le Souef. 4. *L. greeni*. 5 Handle of dorsal median plate (detached). 6. Central and lateral vasical plates (lateral plates on right detached). 7. Ventral median plate. 8 Lateral and tergal plates of tergum V.

LATUMCEPHALUM (BOOPIDAE : PHTHIRAPTERA : INSECTA)

by

THERESA CLAY

BRITISH MUSEUM (NATURAL HISTORY)

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SYNOPSIS

The species of *Latumcephalum* are discussed and a new one from *Wallabia rufogrisus* described.

INTRODUCTION

In Kéler's monograph (1971), this genus was considered and the two known species partly described and figured. Although resembling *Boopia* in the characters of the chaetotaxy, abdomen and male genitalia, the species are separable not only by the horizontal elongation of the head, but in the absence of the trichobothria on segments II-IV and by the characters of the legs. As Kéler (1971) showed, these differ from the legs of all other Boopidae, resembling more closely those of the Ischnocera. This may enable the species to occupy some position on the host, not utilized by other members of the family and which may be less accessible for collecting, explaining their rarity in collections. Or more likely perhaps, these characters make them less able to compete with other genera of Boopidae infesting the same host. Kéler also points out that this genus shares with *Paraboopia*, also rarely collected, the absence of trichobothria on segments II-IV and the reduction of the number of segments in the maxillary palp. In fact, merely the lateral elongation of the head of *P. flava* would give a species similar in appearance to *L. lesouefi*. It is interesting to speculate whether these two genera have lost the form of leg and the trichobothria characteristic of the Boopidae or that these features were never developed and that the species are therefore more similar to the ancestral stock which gave rise to the Boopidae (see Clay, 1970).

The two known species of *Latumcephalum* are distinguished by the shape of the region of the head lying between the preocular and postocular slits, the new species resembling *macropus* in this character. Unfortunately, there is only a single male *macropus* for comparison, in rather poor condition. The new species is distinguished from *macropus* by the size, being nearer to *lesouefi* in this respect, by the shape of the head, the abdominal and femoral chaetotaxy and by the male genitalia. All three species of this genus are parasitic on species of *Wallabia*.

Latumcephalum greeni sp. n.

(Text-figs. 1-8)

Type host: *Wallabia rufogrisus* (Desmarest, 1817).

Male. Outline of head as in Text-fig. 1; chaetotaxy of head and prothorax as figured for *macropus* by Kéler (1971, figs. 130, A. B.), but number of gular setae fewer, 2-3 each side, and the ventral inwardly directed projection on the temple angle smaller.

Meso- and metathorax as figured for female of *macropus* in Werneck & Thompson (1940, fig. 57) except that the marginal setae of the metanotum are now shown: in *macropus* there are 1+1 long setae, with a short fine one on the outer side of each of these; in *greeni* the outer ones are small and sometimes absent and in *lesouefi* the outer ones are almost as long as the inner ones. Second femur without stout spiniform seta as found in males of the other two species (Werneck & Thompson, ibid, fig. 65). In the available material of this species and *macropus* it has not been possible to resolve the exact shapes of all the vesical sclerites in the male genitalia but they seem to be similar in the two species; the elongated, posteriorly bilobed structure characteristic of *greeni* appears to be homologous with the "handle" of the dorsal (anterior) median plate, although it has not been possible to identify its point of attachment (Text-figs. 5-7). The size and shape of the mesosomal arch (sensu Kéler) separates the three species (Text-figs. 2-4).

Abdominal chaetotaxy. It is difficult to give the exact number of setae, as in addition to the main setae there are a number which vary from minute to median in different specimens. Tergum II, 4 central setae; III-IV, 5-6 anterior 4 posterior (= 5-6/4); VII, 5-6/5-6; VIII, 4-6/4-6; with a varying number of segments with a minute to medium seta each end of the rows; the anterior setae are shorter and more spiniform than in *macropus* (Text-fig. 8). In addition, laterally tergum II with one minute seta; III-VII, one long and two associated setae varying from minute to medium. Post-spiracular complex on the lateral plates: II-IV, 1 long post-spiracular and two short setae near its base; V-VIII, one long post-spiracular and three short near its base. Sternum II, 4; III, 4/5; IV-VI, 5/6; VII, 6/6; VIII, 4/6; IX, 2/2. Latero-ventral: II-III, 0; IV-VI, 1 long with 2 of varying lengths at its base; VII, 1 long; VIII, 0.

Dimensions of 3 males (in mm.): Temple width, 0.51-0.52; head length, 0.23-0.25; head index, 2.08, 2.17, 2.22; pronotum width, 0.26-0.28; abdomen width, 0.54-0.57; total length 1.36, 1.40, 1.41.

MATERIAL EXAMINED. 3 males from *Wallabia rufogrisus*, Australia: Tasmania, Greens Beach. 14.1.1973 (R. H. Green).

Holotype: male in the Queen Victoria Museum and Art Gallery, Launceston, Tasmania.

Paratype: 2 males with same data as holotype.

ACKNOWLEDGEMENTS

I am grateful to Mr. R. H. Green, after whom the new species is named, for an opportunity to see this material and other material from Tasmanian animals.

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AN ACCOUNT OF AN ARCHAEOLOGICAL RECONNAISSANCE OF HUNTER'S ISLES, NORTH-WEST TASMANIA, 1973/4

by

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THE PROBLEM

> ... what was then ascertained to be THREE-HUMMOCK ISLAND. The channel which separates it from the land to the west, is, at least, two miles in width, and is deep; so it was difficult to conjecture how the Indians were able to get over to the island. It was almost certain that they had no canoes at Port Dalrymple, nor any means of reaching islands lying not more than two cables length from the shore; and it therefore seemed improbable that they should possess canoes here. The small size of Three-hummock Island rendered the idea of fixed inhabitants inadmissable; and whichever way it was considered, the presence of men there was a problem difficult to be resolved.
>
> Flinders, 1814 p. clxx

Part of Flinders' problem was resolved well before the above retrospective account was published: he was (for once) wrong about the canoes. That the Aborigines of at least some parts of Tasmania had watercraft was established by Labillardière, who accompanied d'Entrecasteaux in 1792 (Labillardière 1800 vol. I p. 230, vol. II plate XLVL).

Other questions remain however: is the idea of fixed inhabitants indeed inadmissable? If so, at what times of the year did Aborigines visit the Hunter Islands? What induced people to make these perilous crossings? For how long had such visits been going on? In this paper I present a preliminary account of an archaelogical project which will attempt to answer these questions.

Matthew Flinders and George Bass in the sloop "Norfolk" were the European discoverers of the cluster of islands in western Bass Strait to which Flinders '...in honour of His Excellency, the governor of New South Wales...gave to the whole the title of HUNTER'S ISLES.' (Flinders 1814 p.clxxiii). The year was 1798; Tasmania was now proven to be an island separated from Australia by Bass Strait. Although Flinders and Bass saw no people on these islands, they noticed deserted fire-places strewn about with abalone shells on the north-east shore of Three Hummock Island, giving rise to Flinders' dilemma quoted above.

Subsequent visitors to Hunter's Isles included Baudin in 1801 (Baudin 1974 pp. 454 ff.); Murray in the 'Lady Nelson' who saw footprints on Three Hummock Island in the summer of 1802 (Lee 1915 p. 125); possibly Oxley in 1810 (HRA III (I) p. 774). In 1813 Captain James Kelly made his first visit to these islands on a sealing voyage with the 'Brothers' (Bowden 1964 pp. 17, 101, 102-3). Three years later he returned in the course of his circumnavigation of Tasmania in a whale boat. On the 3rd January 1816, Kelly was the first European actually to observe Aborigines in Hunter's Isles - or, at any rate, the first who has left us an account. Pulling up on the south end of Hunter Island itself, he encountered a 'large body of natives, at least 50 in number'. The encounter could not be said to have been a success, as Kelly and his men had to make a hasty retreat from a shower of stones (Kelly in Bowden 1964 pp. 30-32). Between 1826 and 1829 surveyors for the Van Diemens' Land Company, Adey, Curr and Hellyer, visited various of the islands (Meston 1958 p. 29).

The most detailed accounts however are those of George Augustus Robinson, who paid a short visit to Hunter Island in 1830 and made an extended stay there in 1832. He suggested that the Tasmanian Aborigines were regular visitors to the Hunter Islands; indeed, that one named local group had its headquarters on Robbins Island (Robinson 19.6.1830 pp. 178-9(1); Plomley 1966 pp. 971-4). Robbins is the most accessible of the group, as it is possible to cross to it on foot at low tide. Robinson also tells us that the Aborigines used to cross to Trefoil Island from Cape Grim on the Tasmanian mainland; from Trefoil to Bird Island; and from Bird to Hunter Island in their 'catamarans' (Robinson 15.8.1832, p. 641). They knew Three Hummock Island well (Robinson 14.10.1832 pp. 668-9); and the main inducement to visit these islands was the muttonbird (Robinson 21.6.1830, p. 181; 18.7.1832, p. 633; 15.8.1832, p. 641; 14.10.1832, pp. 668-9). The muttonbird, *Puffinus tenuirostris*, is a shearwater of strictly seasonal habits. It breeds in densely inhabited rookeries on the offshore islands of Tasmania and spends the southern winter in the northern hemisphere. It is present in the islands of Bass Strait only between late September and early May (Serventy, Serventy & Warham 1971 pp. 128-34).

FIELD WORK PLANNING

My interest in the prehistory of the Hunter Islands stemmed from a general interest in hunter-gatherer communities in coastal situation. As an undergraduate, I had worked on archaeological sites in the Sydney-South coast area of New South Wales, concentrating on the economic and ecological relationships between Aborigines and coastal resources (Bowdler 1970, 1971). This work led me to consider the possibility of examining a hunter-gatherer economy in the extreme coastal environment offered by small offshore islands. In such a situation, the parameters of territory and land resources would be more tightly controlled than in the more complex continental situation; and it might be possible to analyse more closely man's strategies of exploitation and adaption.

When I arrived in Canberra in 1973 to begin work towards a PhD thesis, I was interested in carrying out a combined ethnographic and archaeological project in one of the islands or island groups in the tropical environment of the Arnhem Land coast of the Northern Territory. I was persuaded of the hazards of such a project, as the area is archaeologically unknown and there are difficult logistic and other problems. Rhys Jones suggested I turn my attention to the islands of Bass Strait, which had a greater potential for investigating the kind of problems in which I was interested.

(1) All references to Robinson's journals are to Plomley's edition (Plomley 1966).

From the point of view of the archaeologist, there are two major theoretical and geographical areas of interest in the Bass Strait Islands.

1. The Pleistocene antiquity of man in Australia has now been established and, notwithstanding the lack of actual Pleistocene dates, the colonization of Tasmania prior to 12,000 years ago is demonstrable (Jones 1973). During this period, Tasmania was part of the Australian mainland due to a lower sea level. While it is uncertain whether King Island was joined to Otway Peninsula, there would have been a land bridge between Wilson's Promontory and north-east Tasmania, incorporating the Hogan, Kent and Furneaux groups of islands. It seems likely that Flinders Island and Victoria were separated by the rising sea some 12,000 years ago, and the southern Furneaux separated from Tasmania about 10,000 years ago (Jennings 1959, 1971). The eastern Bass Strait should therefore be a significant nexus in the prehistory of man in Australia and Tasmania. The Furneaux, Kents and Hogans (and King Island) were however uninhabited at the time of European discovery (Flinders 1801 p. 46). There have been reports of surface finds of stone artefacts from Flinders Island, but there are no detailed descriptions, and they are as yet stratigraphically unconfirmed (MacKay 1946; Tindale 1940; D. A. Casey & S. Murray-Smith, personal communications).

Flinders Island presents a fascinating problem in island human geography: was it too small to support a viable isolated population, or did people gradually retreat elsewhere in the face of the rising sea? The situation is directly analogous to the prehistory of Kangaroo Island, South Australia (Tindale 1957, Lampert 1972). Despite these interesting possibilities, it seemed that a lot of time would be necessary to investigate them,which might be better spent in an area of greater known archaeological potential.

2. In western Bass Strait, the Hunter Islands were known to be visited by the Tasmanian Aborigines, as can be seen from the account above. In 1936, A. L. Meston visited Hunter Island and described archaeological sites: firstly, a large cave on the east side of the island with two fireplaces and shells scattered about the floor (the 'Cave Bay Cave'); secondly, substantial midden deposits in Cuvier Bay on the west side of the island. He also found eroded middens on Three Hummock Island (Meston 1936 pp. 155-6). The Cave Bay Cave was also brought to the attention of Rhys Jones by Mrs. Macdonald of Marrawah, Mr. Walker of Devonport and Mr. Pat Maguire of Hunter Island. Mr. Duncan Macdonald of Devonport had given descriptions of archaeological sites on Hunter Island, including the cave, to Mr. Frank Ellis of the Queen Victoria Museum, Launceston, who made this information available to me. The presence of middens on the east side of Three Hummock Island was confirmed by Mr. Charles Turner of Burnie. F. L. Sutherland also briefly describes a visit to Hunter Island where he collected stone artefacts from midden sites and the Cave Bay Cave (1972 p. 46).

These islands, with a wealth of known archaeological sites and good ethnographic accounts, seemed to present an ideal situation for investigating the use of islands by hunter-gatherers. The final point which made the project desirable is that the Hunter Islands are not located in archaeologically unknown territory. The basic sequence of the last 8,000 years of Tasmanian prehistory has been elucidated by Jones in the north-west and Lourandos in the south-east (Jones 1966, 1971b; Lourandos 1970); and the Hunter group is strategically placed in relation to Jones' important Rocky Cape sites and also West Point (fig. 1). Hence, in initiating an archaeological project in the Hunter Islands, I was not constrained by the broad pioneering problems of sequence, typology and age, but could concentrate on more specific and local relationships of man, land and sea. As is inevitably the case in a project involving field survey and excavation, new problems have arisen which alter somewhat the original emphasis; but the basic one of hunter-gatherer strategies in the exploitation of offshore islands is still central to the project.

FIELDWORK

I first visited the Hunter Islands in June 1973, and made short day trips to Three Hummock, Hunter and Trefoil Islands. On the north end of Coulomb Bay, Three Hummock Island, I saw the 'native carvings' (plate 1) mentioned by

Mrs. Eleanor Alliston (1966, map on endpapers), but not previously investigated by an archaeologist. The carvings are incised on a large slab of granite, and in style and technique bear a strong resemblance to those at Mr. Cameron West (e.g. McCarthy 1970 p. 63). They may thus be included in the stylistic group represented at sites round the west and north-west Tasmanian coast from Port Davey to Devonport (Jones 1966 p. 2, Sims 1974). Close to the carvings is a small midden site, itself in proximity to a modern muttonbird rookery. I visited the Cave Bay Cave and saw a number of middens on the west side of Hunter Island, south-west of the homestead, and a small stabilised midden on the south-east side of Trefoil Island, now one of the foremost commercial mutton-birding islands (fig. 2).

I returned to Tasmania in October 1973 and established a base on Hunter Island, with the permission of the lessee Mr. Pat Maguire. I spent November and December reconnoitring for sites, and surveyed intensively about 12 miles of coastline and some of the interior of the island. I was able to locate and map 129 sites, ranging from small superficial scatters of shell up to large stabilised middens, with some rock shelters and the Cave Bay Cave. A detailed analysis of this material should provide information about some of the topographical determinants of site size, type and location and hence exploitative strategies.

From the 6th to the 15th November I was joined by Mr. R. H. Green and Mr. Terry Cashion of the Queen Victoria Museum, who conducted a faunal survey. During this period I wished to sample a site by excavation, and take advantage of Bob Green's expertise in identifying faunal remains. I selected the Stockyard Site because it was near my base camp and because it was small but appeared to be largely *in situ*. The results are described below.

After a short Christmas break in Hobart, I returned to Hunter Island with some assistants, and we excavated the Cave Bay Cave, the Muttonbird Midden and the Rookery Rock shelter. The excavations and preliminary results are described below. In March 1974 I was joined by Winifred Mumford of the Department of Prehistory, Australian National University, who mapped the excavated sites. With her assistance, we dug a small sounding into the Little Duck Bay midden and excavated another square metre of the Stockyard Site. We left Hunter Island on the 18th March, 1974.

I now wanted to examine some of the smaller islands round Hunter, to see how many bore traces of Aboriginal visits. While we know from the ethnography and the presence of sites that the Tasmanians were able to get to Trefoil, Hunter and Three Hummock Islands, it would be interesting to see if there were any limits to their seagoing ventures. With the help of Mr. Alan Anson, of Tasmanian Seafoods, Smithton, I was able to go aboard the cray-boat of Mr. Mac Humphries of Smithton on the 22nd March. Mr. Humphries and his crewman Mr. Collie Green put me ashore on Stack Island, where a presumed Aboriginal skeleton was found in the 1920's (Meston 1936 p. 156; Smith 1968 p. 172). Here there are four eroded middens, and on Sea Crow Islet there is also an eroded midden. The next morning we were fortunate to be able to go ashore on Steep Heads Island, a difficult one on which to land due to the nature of the shoreline, which consists for the most part of sheer cliffs. We landed on a relatively gentle shingle bank; this would appear to be the only place a dinghy, let alone a bark catamaran, would be able to land. I examined this stretch of coast as far as possible and found no trace whatsoever of Aboriginal occupation or visitation. It seems therefore that Steep Heads was not visited by Tasmanian Aborigines; or at least, not with sufficient regularity to leave any trace.

I returned to Canberra on the 28th March 1974.

HUNTER ISLAND: THE SETTING

Hunter Island is about 24 km long and 6 km across at its widest, with an area of about 8500 hectares. It lies about 6 km off the Tasmanian mainland, from which it is separated by an extremely dangerous strait, the danger being due to massive tidal rips (Flinders 1814 pp. clxxi-clxxii; Robinson 7.6.1830 p. 176; Jennings 1959 p. 63). Geologically, ' it consists entirely of largely unmetamorphosed Precambrian slate, siltstone, quartzose sandstone and rare dolerite dykes' (Sutherland 1973 p. 135). The topography is gentle, the highest point

being 90 m above sea level. Vegetation is predominantlv low coastal heath, with extensive areas now maintained as cattle pasture. Adjacent to the shoreline on the western side are extensive areas of tussock grassed sand dunes which are generallv coincidental with muttonbird rookeries. There are several patches of tea-tree swamp, probablv fewer now than hitherto, due to clearing and draining for pasture. Bracken fern is abundant in several places. There is no lack of fresh water in creeks and soaks.

Hunter Island supports an extensive bird life. As well as muttonbirds, breeding seabirds include pacific and silver gulls, pied and sootv oystercatchers, dotterels and fairy penguins. There is at least one nest of a white-breasted sea eagle on the island, and the nest of a nankeen kestrel in the Cave Bay Cave. Black swans, yellow-tailed black cockatoos, rosellas, eastern swamp hens, ducks of at least three species, currawongs, ravens, plovers and manv more species may be seen on the island, and around its coasts albatross, gannets, terns, cormorants and pelicans are frequent visitors.

Indigenous mammals now present are the pademelon (*Thylogale billardierii*), marsupial mouse (*Antechinus minimus*), water rat (*Hydromys chrysogaster*) and possiblv the velvet-furred or eastern swamp rat (*Rattus lutreolus*). The ringtail possum (*Pseudocheirus peregrinus*) is a recent introduction (or reintroduction?), together with feral cats. There are domesticated dogs, horses, sheep and cattle. Rabbits apparently made a brief appearance in the 1930's, but were quickly removed from the stage. Tiger, copperhead and whip snakes, bluetongue lizards and other skinks make their home here. There are two or three species of frogs, and galaxiid fishes swim in the creeks (R. H. Green, personal communication).

Parrot fish abound in the offshore waters; trevallv, luderick, trumpeter and blackbacked salmon are among the manv other species of scale fish. Abalone (*Haliotis ruber*) and crayfish (*Jasus lalandei*) are present just offshore, but possibly less abundantlv than previouslv due to commercial exploitation in modern times. Warreners (*Subninella undulata*), limpets (*Cellana*), *Austrocochlea*, other gastropods and mussels and cockles can be seen between the boundaries of the tides. The giant kelp flourishes on the western rockv coasts of the island; and here too occasional sightings of seals have been made (Pat Maguire personal communication). Hunter Island may have held no great attractions to the European eve (e.g. Oxlev in HRA III (I) p. 774), but would present a rich landscape to those who lived close to, and off, the land.

EXCAVATIONS ON HUNTER ISLAND, SUMMER 1973-4

The same general excavation procedure was followed at all sites. The deposit was removed with trowels, following the stratigraphy where possible. It was placed in buckets, then sieved through a 3/16 inch mesh. All cultural material was saved except shells, and shell samples were taken from the sides of excavated trenches. Excavation proceeded in areas 1 m square. All sites were backfilled after the sections had been drawn and photographs taken.

1. The Cave Bay Cave (mv code number: HIS/HUN/1) Fig. 2, plate 2)

This is the cave on the east side of the island described by Meston (1936). It is around the cliff from Pat Maguire's jettv in the bav called Cave Bay; so I have called the cave, in a rather circular fashion, the Cave Bay Cave. It is a large sea cave in a cliff of Precambrian slate. In size it is about 25 m across at the entrance and runs back into the cliff to a depth of about 50 m. The roof at the entrance is about 12 m high, and the entrance is about 25 m above the rocky shoreline. The floor is a fine flourv dust with fragments of shell and bone visible to the far end of the cave. There are three concentrated patches of shell visible on the surface (no doubt the fireplaces described by Meston, *op. cit.*). Other features are a kestrel's nest, and two mounded depressions caused by constant water drips. The walls of the cave bear numerous graffiti, nearlv all names and dates. We made a record of these, as far as they were legible. The oldest reads 'Walrus 1867'. There was apparently a boat of that name which sailed from Devonport to King Island in that vear (Pat Maguire, personal communication).

Trench I We first excavated a trench 4 m x 1 m across the entrance. The maximum depth of deposit excavated was about 1 m. Deposit continues below this depth but we were unable to excavate further because of massive boulders of exfoliated slate embedded in the deposit.

The top 5 to 15 cms of deposit contained evidence, albeit sparse, of human occupation. The surface of the deposit is a fine grey-brown powdery soil. Immediately beneath this was a thin complex of hearths and scorched yellow-grey material. Within this complex, about 9 stone artefacts were associated with the bones of small birds, rats and *Isoodon obesulus* (the brown bandicoot). One of the problems of working in a cave site such as this is the possibility that it has been the haunt of carnivorous birds and/or mammals who have left their own food debris behind, (cf. Dortch & Merrilees 1971 pp.111-2). A more detailed analysis is therefore necessary before I can confidently distinguish the dietary remains of Aboriginals from those of non-human users of the cave. One of the stone artefacts is a small steep-edged scraper in an almost transparent rock crystal; (fig. 3) the other eight are primary flakes of local quartz or quartzite.

Below this complex was about 35-40 cms of finely divided grey-brown soil which is probably culturally sterile, containing only the bones of small birds.

Beneath this sterile layer was further evidence of human occupation. Stone artefacts, charcoal, shells and the bones of more and larger animals reappeared in a matrix of crumbly orange-brown deposit. At least 17 stone artefacts were recovered, with the remains of muttonbird, rat, brown bandicoot (*Isoodon*), ringtail possum and pademelon. The stone artefacts were either simply flakes or crudely flaked pebbles, of quartz or quartzites easily found on the foreshore immediately below the cave.

Within this orange-brown layer at the west end of the trench, about 55 cms below the surface, we found a concentration of material within an area of about half a square metre. Four extremely well-made and beautifully preserved bone points (fig. 4) were associated with two large pebbles with signs of pitting or abrasion and a pebble 'chopper' (fig. 3), and a large amount of bone. This bone does seem to be almost certainly human food refuse and a preliminary sorting indicates the following minimum numbers of animals:(I)

pademelon:	5	
wallaby:	1	(+ 4 wallaby fibulae made into bone points)
muttonbird:	8	
fairy penguin:	1	
rat:	1	
small birds:	2	
parrot fish:	1	(2 pre-maxillae + other head bones)

There are immediate chronological implications: at no excavated site in Tasmania have bone points or fish bones representing food debris been recovered from contexts less than 3,500 years old (Jones 1971b, pp. 503 ff., 541, 608, 619-620); Lourandos 1970 pp. 52-4).

Trench II Being thwarted by the roof fall from proceeding further with Trench I, we decided to excavate in the far recess of the cave. We excavated a single square metre here and managed to dig to a maximum depth of 1.75 m. There was evidence of human occupation to a depth of at least 1 m.

The top 20-25 cms consisted of interleaving hearths and lenses, rather like a micro-version of Rocky Cape South (Jones 1966, plate I). This area of excavation was rich in bone, and stone artefacts were more common in this stratigraphic unit than in Trench I. A total of 214 pieces of worked stone was recovered from the top 20 cms of deposit, and the majority of these were small quartz flakes. A preliminary sorting of bone from this square was carried out in the field.

(I) All minimum numbers of animals have been calculated by counting the most commonly occurring bone of any species, genus or family as identifiable, within any excavated trench or square; here, for instance, the numbers of pademelons were calculated by left pelvis and muttonbirds by right tarsometatarsus.

Minimum numbers of animals for this top stratigraphic unit are:

muttonbird:	5	
small bird:	64	
large bird:	2	
rat:	46	(*Rattus* and *Mastacomys*)
pygmy possum:	1	(*Cercartetus sp.*)

Shell was common in this unit, forming small concentrations of midden deposit.

Below this top unit, a layer of compact white deposit occurred, which may represent something of a hiatus in occupation. No stone artefacts were found, and the density of charcoal and bone decreased sharply. A few isolated shells were present. Minimum numbers of animals represented here were:

muttonbird:	4	
parrot:	2	
raven/crow	2	
small bird:	23	
large bird:	2	
rat:	8	
marsupial mouse:	1	(*Antechinus sp.*)

Underlying the white layer 35 cms to 1.20 m below the surface, is a fine grey-brown deposit, crumbly in places and containing localised bands of white limy flecks. Five stone artefacts and one bone point were recovered from this layer. Charcoal was more prevalent here than in white layer, and bone was abundant. There was no shell. Minimum numbers of animals represented here were:

small bird:	27	
large bird:	3	
rat:	466	
marsupial mouse:	42	
pygmy possum:	14	
pademelon/wallaby:	2	
possum:	2	(*Pseudocheirus*, the ringtail possum)
native cat:	3	(*Dasyurus sp.*)
bandicoot:	10	(*Isoodon*, the brown bandicoot and *Perameles*, the barred bandicoot)
wombat:	1	

The complete absence of shell from this layer would not seem to be due to poor preservation as the bone is in perfect condition.

A layer of paler, crumblier soil at the bottom of the excavation is almost totally devoid of anything but pieces of exfoliated slate. We did not reach bedrock, but the north wall of the cave started to slope steeply into the square here.

The faunal remains from Trench II present an interesting sequence, and can be summarised as follows:

	MINIMUM NUMBERS				
	mutton-birds	other birds	rats	(*Antechinus* + *Cercartetus*)	Larger marsupials
Top complex 0-20 cms	5	66	46	1	0
White layer 20-35 cms	4	29	8	1	0
Lower complex 35-120 cms	0	30	466	56	18
	9	125	520	58	18

The lowest stratigraphic unit shows the following significant contrasts with those above it:

1. The absence of muttonbirds in the lower unit and their presence in the top two units. A Chi^2 test shows this to be highly significant at better than the 0.1% level.

2. The decrease in the numbers of other birds in the lower unit as compared with those above it. A Chi^2 test shows this also to be significant at better than the 0.1% level.

3. The increase in rats in the lower level, also significant at better than the 0.1% level.

4. The increase in the small marsupials *Antechinus* and *Cercartetus*, also significant at better than the 0.1% level.

5. The presence of larger marsupials in the lower unit and their absence from those above it. This is significant at the 2% level.

A further point, not statistically tested, is the absence of shell from the lower unit and its presence in the upper two units.

While the fauna may not represent exclusively human dietary remains, it must at least be a reflection of the local environment. The most economical explanation of this sequence would seem to be that the lower unit is of Pleistocene age. During the Pleistocene, Hunter Island would have been part of the Tasmanian mainland, and the shoreline anything up to 75 km away. This would explain the absence of shellfish and the coastal muttonbird; possibly the decrease in other birds, should some of them prove to be seabirds; the presence of native cat, wombat, and *Perameles* - none of which are now present on Hunter Island, nor are they represented in more recent sites; and the comparative abundance of land fauna generally.

The lowest definite human artefacts from Trench II are a bone point (fig. 4) and two pieces of flaked quartz from between 80 to 100 cms below the surface. A charcoal sample from this level has been submitted for radiocarbon dating to the A.N.U. laboratory. The results indicate an age in excess of 18,000 years. (I)

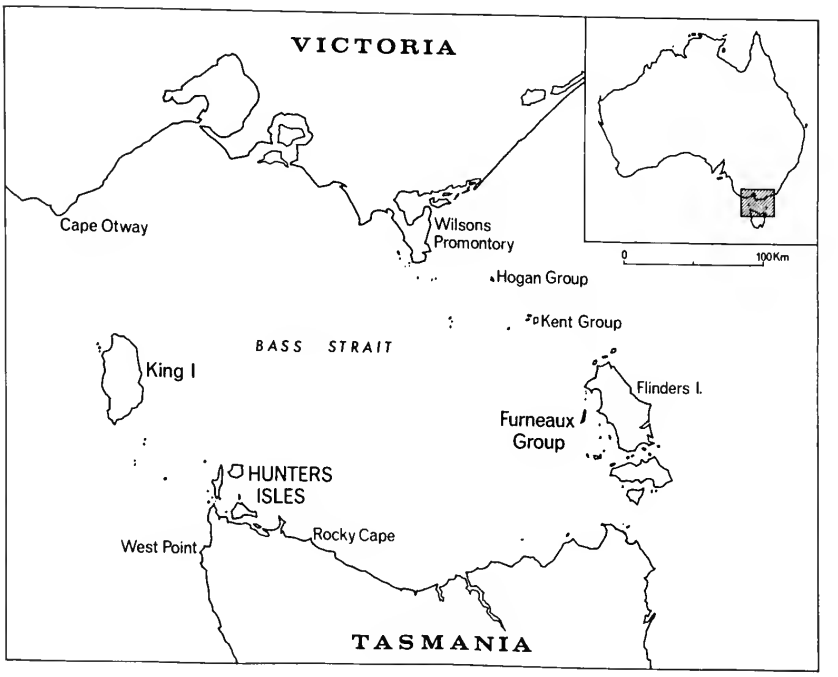
We may therefore postulate the human occupation of this cave beginning some time prior to 18,000 years ago. If the white layer does indeed represent a hiatus, it is possible that this was a period after the island had been severed from Tasmania; that it had no permanent inhabitants and was not visited by sea. We know however that visits by the Tasmanians must have commenced prior to 3,500 years ago, on the evidence of the bone points associated with shells in Trench I. There may well have been a period, say between 8,000 and 5,000 years ago, when the Tasmanians gradually perfected their methods of seacraft and navigation culminating in landfalls on Hunter Island by Tasmanian Cooks and Columbuses; who, like their latterday counterparts, opened up the islands to the exploiters who followed in their wake.

Further excavation of the Cave Bay Cave is imperative, with the prime target of excavating a large area in the vicinity of Trench I, to circumvent the problem of the boulders and try and excavate to a depth representing an equivalent antiquity as the lower part of Trench II. The presence of vegetable matter - leaves, twigs, decayed wood - to some depth in Trench II suggests that the application of flotation and other modern techniques would be rewarding.

2. The Muttonbird Midden (HIS/HUN/79) (fig. 2) (plates 3,4)

This site is in a small gully on the west coast, right in the large south-west muttonbird rookery. A large part of it is now eroded, no doubt the result of a combination of muttonbird burrowings and raging westerly winds.

(I) Henry Polach and John Head, personal communication:
Final: 18,550 $\pm$ 600 years B.P. (ANU-1361)


VICTORIA
Cape Otway
Wilsons
Promontory
Hogan Group
Kent Group
BASS STRAIT
King I
Flinders I.
Furneaux
Group
HUNTERS
ISLES
West Point
Rocky Cape
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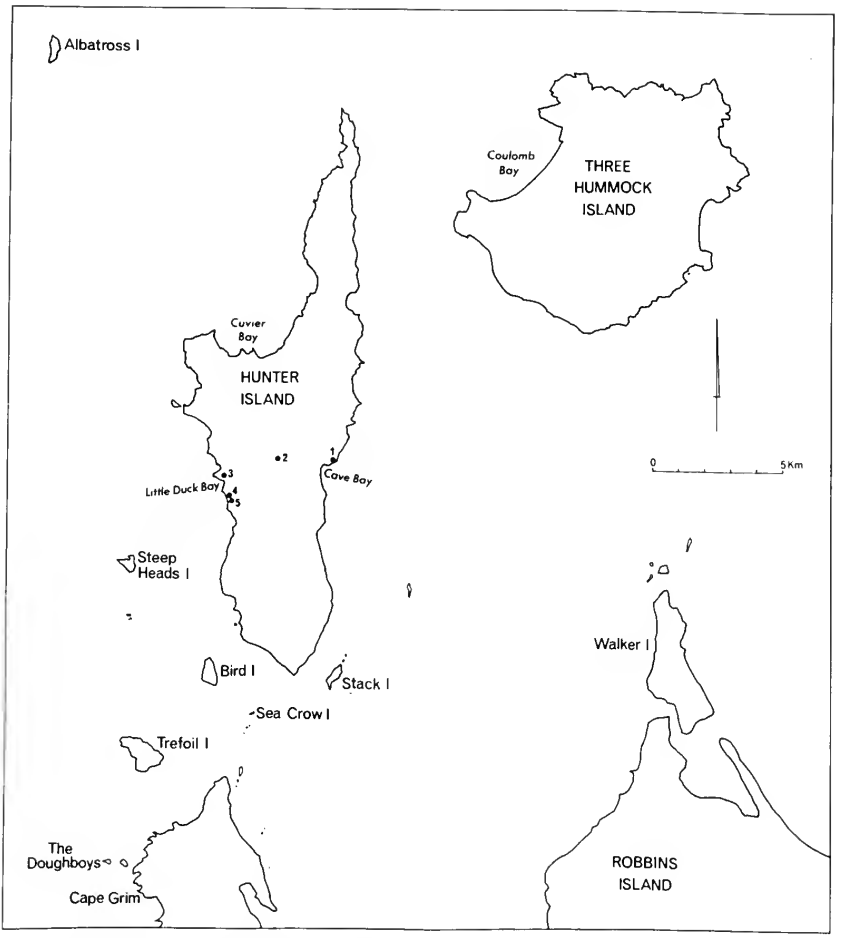

FIGURE 2. Archaeological sites: 1. Cave Bay Cave; 2. Stockyard Site; 3. Little Duck Bay Site; 4. Rookery Rock Shelter; 5. Muttonbird Midden.

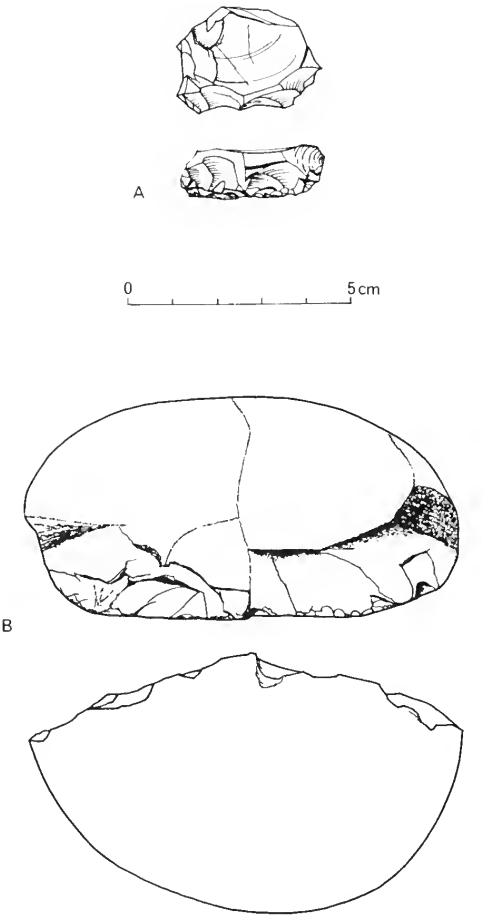

FIGURE 3. a. steep edge scraper, Trench I, Cave Bay Cave
b. pebble chopper, Trench I, Cave Bay Cave

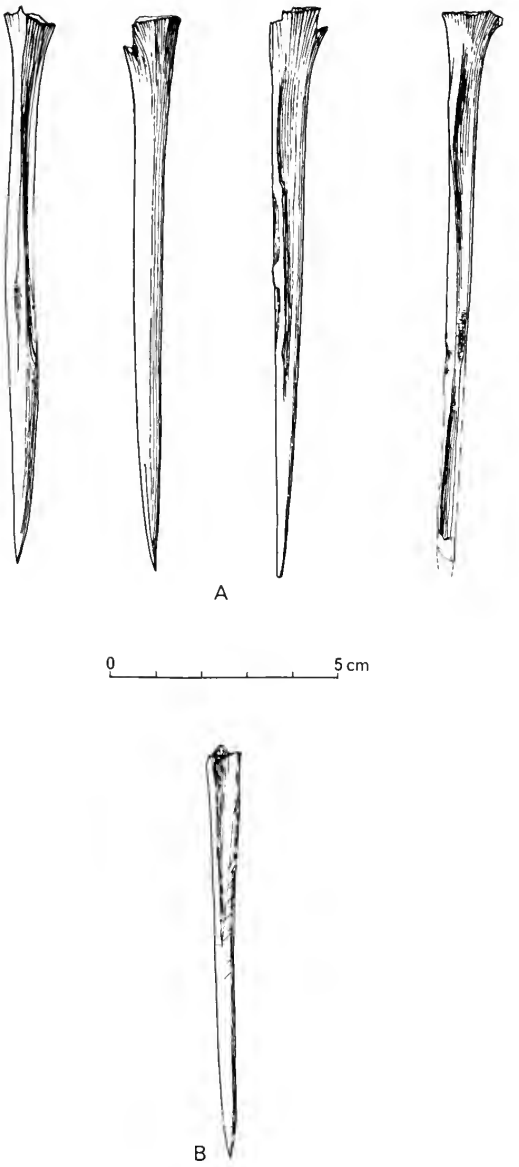

FIGURE 4. a. bone points, Trench I, Cave Bay Cave
b. bone points, Trench II, Cave Bay Cave

PLATE 1. Rock engravings, Three Hummock Island

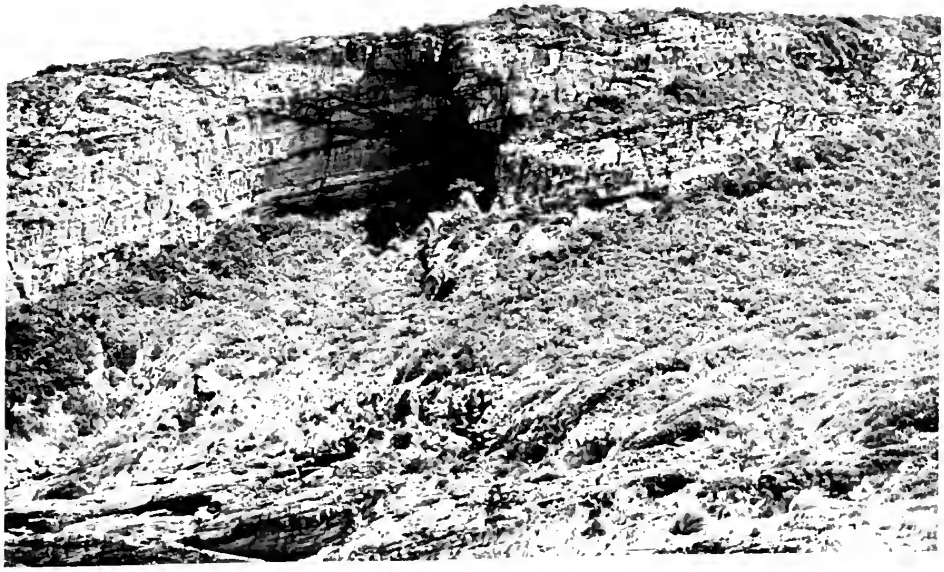

PLATE 2. a. Cave Bay Cave, Hunter Island

b. Trench II, Cave Bay Cave. Foil reflectors were used, due to the lack of light in the back of the cave.

PLATE 3. a. Looking over the Muttonbird Midden, to the Rookery Rock shelter, Hunter Island.

b. Exposed face of Muttonbird Midden before excavation.

PLATE 4. Muttonbird midden after excavation, showing 'burrows'.

Originally the site must have covered an area of about 7,500 sq m but about 200 sq m is *in situ*. This stabilised portion presents an exposed face to the west, overlooking a small soak 50 m from the rocky shore. Compact shell midden overlying brown sand overlying yellow sand could be seen in this exposure. We excavated a trench 1 m x 5 m in area with the long axis at right angles to the exposed face, which we had first cleaned up. Maximum depth of the excavation was slightly over 1 m.

Relatively shallow muttonbird burrows, taking advantage of tussock grass as cover, occur here and there on the surface of the site. Our trench in fact sectioned one such burrow, which contained a muttonbird chick, the month being February. A pile of yellow sand overlying the surface of the midden was also sectioned by the trench, and seems to be upchuck from a deeper burrow on the edge of the stratified part of the site.

The top 20 to 40 cms of cultural deposit consists of compact shell midden. Stone artefacts were more common here than in the cave excavations, while bone, somewhat surprisingly, was a good deal sparser. About 500 artefacts were recovered, again mostly primary flakes of quartz and quartzite. Two pieces of fine-grained chert and two of spongolite were found, both materials being exotic to the island (cf. Sutherland 1972). These had fine secondary working on the margins. The remains of 3 muttonbirds, 1 penguin, 1 other large bird, 1 pademelon, 1 marsupial mouse (*Antechinus*), 1 brown bandicoot (*Isoodon*) and pieces of cuttlefish were recovered. Charcoal was abundant in this layer.

Underlying this midden unit is a layer of brown sand between 40 and 45 cms thick. It contained some whole shells and fragments, bones, charcoal and stone artefacts throughout. About 150 artefacts were excavated, including one of chert. The bone represents 4 muttonbirds, 2 pademelons and 1 rat.

Beneath the brown sand is culturally sterile yellow sand. At the junction of the brown and yellow sand we encountered some interesting features There seemed to be holes in the yellow sand filled with the brown deposit (plate 4). If the yellow sand represents the natural dune upon which occupation debris has built up, there seems no natural physical explanation for these holes. Their size, shape and spacing suggests that they are prehistoric muttonbird burrows. We have then an interesting chronological sequence of muttonbird rookery overlying human occupation site, overlying muttonbird rookery. This sequence, together with the muttonbird bones found throughout the occupation layers, would seem to suggest a strong association of man with muttonbirds. I have submitted charcoal from the bottom of the brown sand to the A.N.U. Radiocarbon Laboratory for dating. This date should be of some interest not only to archaeologists, but (if my interpretation of the 'burrows' is correct) to zoologists also.

3. The Rookery Rockshelter (HIS/HUN/80) (fig. 2., plate 3)

This small rock shelter is situated in the southern side of a hill which forms the northern boundary of the gully in which the muttonbird Midden is situated. It is a fissure in bedded Precambrian quartzite, and has a southern aspect, looking over the midden. The floor of the entrance is 15 m above sea level, and is about 30 m from the shore. The entrance is 3 m across and 3 m high, and the shelter is 5 m deep. The floor when I first saw it was covered with pigface (or a similar succulent). No sign of Aboriginal occupation was discernible but, by tearing away some of the succulent and scraping off some of the fine sandy grey soil beneath it, I was able to see some limpets and charcoal.

We excavated a square metre near the entrance to a depth of about 85 cms. At this depth we were obstructed by exfoliated rock fall - in this case, large lumps of quartzite. We then extended the cutting 50 cms to the west, which brought the trench up to the west wall of the shelter. Having excavated this half metre to a similar level as the initial cutting, we continued the excavation over the combined area 1 x 1.50 m to a maximum depth of 1.70 m.

The top 50 cms of deposit contained evidence of human occupation. Lenses of shell and charcoal were interspersed with lenses of fine grey sand containing charcoal and shell fragments. This stratigraphic unit contained at least 6 artefacts, of which 5 were primary flakes and one a spongolite flake with secondary working. This last was found about 35 cms below the surface. At the same depth was the pre-maxilla of a parrot-fish, which could indicate an age of 3,500 years or more. Other animals represented in this unit were muttonbird, other bird, rat, pademelon, marsupial mouse (*Antechinus*), bandicoot (*Isoodon*) and cuttlefish.

From 50 cms to 1 m below the surface there was a sterile layer of yellow sand.

Below the sterile layer was 25 to 45 cms of black deposit which contained 3 pieces of quartz which are probably artefacts, a few rat bones and a certain amount of charcoal. Many large quartzite rocks were present at this depth. Rhys Jones, while visiting me in the field, suggested they are the result of periglacial weathering, which would have taken place in late Pleistocene times. The evidence for human occupation in this layer however is not definite.

Underneath this black layer was 15 to 25 cms of yellow to white sand, beneath which was the quartzite bedrock.

4. The Stockyard Site (HIS/HUN/3) (fig. 2)

This small midden is almost exactly in the middle of the island. It is about 2 km from the sea to both east and west. It is oval-shaped grassy mound, somewhat truncated by Pat Maguire's stockyard. Its apex is about 1 m above the surrounding flat marshy paddock, and is about 185 sq m in area.

I excavated one square metre in November and extended this by another metre in March. The maximum depth excavated was 75 cms and the maximum depth of cultural deposit 60 cms.

There is 5 cms of topsoil overlying 30 cms of shell midden. This midden layer is divisible into two units: 15 cms of very compact shell midden, overlying 15 cms of rather looser shell midden containing many more large, whole abalone shells than the compact midden. Beneath the midden is 30 cms of chocolate brown to dark orange sand containing fragments of shell and a few whole ones, charcoal, stone artefacts and animal bones. This rests on sterile yellow sand.

The stone artefacts consisted of about 200 primary flakes, a few showing signs of use. All are made of local quartz or quartzite.

Minimum numbers of animals represented in both squares are:

Compact midden,	fairy penguin:	1	
	pelican:	1	
	other bird:	3	
	rat:	3	(*Rattus*)
	pademelon:	1	
	potoroo:	3	
	bandicoot:	1	(*Isoodon*)
	fur seal:	1	
Looser midden,	muttonbird:	8	
	pelican:	1	
	other bird:	1	
	water rat:	1	(*Hydromys*)
	pademelon:	5	
	potoroo:	2	
	bandicoot:	2	(*Isoodon*)
	blue tonge lizard:	3	
Brown sand,	rat:	2	(*Rattus*)

In the compact midden there was also a single fish vertebra. This does not of necessity represent food debris; it may, for instance, have been in the stomach of a pelican or seal.

The absence of muttonbird from the compact midden was striking. The method of calculating minimum numbers obscures this somewhat as only the most common bone of a species is counted. In this case it was the right carpometacarpal which was only found in the looser midden; but other muttonbird bones were present in the brown sand, while there were none at all in the compact midden. To demonstrate this statistically I carried out a Chi^2 test on the proportions of muttonbirds measured against all other species using the minimum numbers, and combining the lower two units to be tested against the compact midden. This showed that the absence of muttonbirds from the compact midden was significant at between the 1% and 2% levels. Is the fluctuation seasonal, or does it represent a change in cultural preferences over a longer period of time? Or was there a decrease in the muttonbird population?

5. The Little Duck Bay Site (HIS/HUN/2) (fig. 2)

This is a stabilised midden site on top of the hill forming the north arm of Little Duck Bay. I will not describe it in detail here, except to mention that it has two of the circular depressions which have been interpreted as hut sites when found on the west coast of Tasmania (Jones 1947; Jones 1971a p. 278; Lourandos 1968 pp. 42-3).

I excavated a small sounding 50 x 50 cms to a depth of 30 cms. This site appears to be rich in stone artefacts as at least 130 were recovered from this small cutting, including one spongolite flake. It is also rich in bone, especially the remains of fur seal. Penguin, rat, pademelon and bandicoot are also represented.

I intend to return to this site, for three reasons:

1. to obtain a large bone sample, especially of seal;
2. to obtain a good stone artefact sample;
3. to expose a large area in order to examine closely the structure of the depressions. The deposit does not appear to be particularly deep.

DISCUSSION

At least 18,000 years ago the ancestors of the Tasmanian Aborigines were sheltering in a large inland cave looking out over Bass Plain, little knowing that vast amounts of their territory would be inundated in the coming millenia, and the ridge in which their cave was situated would become first a peninsula, and finally a tiny offshore island. Can we arrive at a clearer picture of the period during which the rising sea severed Hunter Island from Tasmania and document the effects of this on man and beast?

After Hunter Hill became Hunter Island, the Tasmanians left evidence in the form of shell middens of their visit to Hunter, Three Hummock, Stack, Trefoil and Sea Crow Islands. They did not apparently visit Steep Heads Island, and, if they found this too difficult, I would be surprised if they ever went to Albatross Island, as Meston suggests (1936 p. 161). The fact that there is a Tasmanian name for Albatross (*Tangatema*: Meston, *ibid.*, from Ling Roth 1899 appendix p. xliv) may be simply because Albatross was clearly visible from some parts of Hunter. It would seem even more difficult to land on Albatross than Steep Heads (e.g. Flinders 1814 pp. clxxi-clxxii; Robinson 7.10.1832, p. 663; Ashworth & Le Souef 1895). Of course, there would always have been the foolhardy few who may have made it, but it seems unlikely that any regular trips would have been made to Steep Heads, Albatross Island or the Black Pyramid.

The reconnaissance of Hunter Island has raised a number of problems. The Muttonbird Midden supports Robinson's suggestions that people went to Hunter to exploit the mutton-bird which in itself further implies they went in summer. But did they never go in winter? And the Stockyard Site, and possibly the Little Duck Bay site, raises doubts about the muttonbird as a universal answer. What part was played by the seal? And, indeed, the rat, which, on the evidence of the Cave Bay Cave site, may have had a long history as the quarry of Tasmanian hunters in this region. In fact, all these sites show a somewhat surprisingly

heavy reliance on land fauna. What has happened to animals such as the brown bandicoot, which is represented in relatively recent sites, but is not now found in any of the Hunter Group? Why is the stone tool repertoire at most sites so poor? What proportions of exotic raw materials were imported, and for what purpose? What relationships, chronologically, seasonally and otherwise are there between the various sites?

I hope to be able to attack these problems by detailed analysis of material already recovered, and further fieldwork; in particular, a concerted attack on the Cave Bay Cave.

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MISCELLANEOUS NOTES ON ENDEMIC TASMANIAN PLANTS IN THE GENERA

OLEARIA, IXODIA, XYRIS, DANTHONIA, TETRARRHENA

by

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COMPOSITAE

Olearia lanceolata (Benth.) D. I. Morris, stat. et comb. nov.
Olearia persoonioides (DC. ut *Eurybia* sp.) Benth. var. *lanceolata* Benth., *Fl. Austral.* 3, 471 (1867)

In the Tasmanian Herbarium, Bentham's variety *lanceolata* of *Olearia persoonioides* is represented by a specimen labelled in Leonard Rodway's handwriting but without details of locality, collector, or date. The status of this taxon remained in doubt until, in November 1973, Dr. and Mrs. D. Ratkowsky collected from Eaglehawk Neck, and later from other localities in the south-east, material of plants which appear to agree with Bentham's description of *Olearia persoonioides* var. *lanceolata* and which match the earlier specimen named by Rodway.

These plants differ considerably in floral and vegetative characters from *O. persoonioides* and occupy entirely different habitats. Bentham's variety is found in light forest in the south and east of the State from near sea level to an altitude of about 300 m; *O. persoonioides* is found on the central plateau and on exposed slopes of mountains at altitudes of from about 600 to 900 m.

Bentham's variety is now raised to specific rank but, since it has not been possible to locate his type, a neotype has been selected.

NEOTYPE: Cash's Lookout, Eaglehawk Neck, Tasmania - *D. & A. Ratkowsky*, 10.xi.1973 (HO).

DUPLICATES: (K, Herb. Queen Victoria Museum Launceston).

Following is an amplified description:

A stout erect shrub up to 2 m high. Leaves alternate, shortly stalked, coriaceous; blade up to 8 cm long, narrowly oblong-elliptical, apex rounded or shortly emarginate, margins shortly recurved, upper surface dark green, shining, with paler raised reticulate venation, lower surface with a dense buff-coloured tomentum of T-shaped hairs. Flower-heads numerous, stalked, 1 - 3 together on a common peduncle, the peduncles in axils of the uppermost leaves of the current seasons growth, longer than the leaves. Involucre turbinate, 8 - 11 mm long; phyllaries narrow-lanceolate, tomentose, divergent. Florets white, c. 35, of which 6 - 10 are ligulate, ligules c. 1.2 cm long, 5 mm wide. Achenes c. 3 mm long, glabrous except for a ring of short woolly hairs below the pappus; pappus ± equalling the disc florets, straw-coloured, barbellate, with slightly plumose tips.

Ixodia achlaena D. I. Morris, sp. nov.

Frutex rigidus, erectus, ramosus, usque ad 2 m altum, ramis in pseudo-verticillis e subter inflorescentiis annotinis orientibus; rami juniores, folia et pedunculi tomento albo (quod sub exsudato denso, viscido, luteo celatum est) praediti. Folia alterna, diffusa vel recurvata, usque ad 2.5 cm longa, anguste linearia, marginibus valde recurvatis paene paginam inferiorem tomentosam occultantibus; folia juniora flavo-virentia, atro-viridescentia. Capitula plurima, breviter pedunculata, in corymbis densis applanatis disposita qui in ramis summis terminales sunt. Involucrum ca. 5 mm longum, cylindricum, tegulis flavo-virentibus scariosis. Tegulae extimae ovatae-lanceolatae, obtusatae, ad basim lanatae viscidae; intimae laminis conspicuis radiantibus lactaneis ornatae, laminae dimidio breviores quam ungues anguste-lineares. Receptaculum plus minusque complanatum, squamis nullis; flosculi 4 - 5, hermaphroditi, involucrum aequantes vel parum superantes. Corolla straminea, ca. 3 mm longa. Antherae caudatae; stylus ad basim bulbosus; stigmata capitata, minute papillata. Achenium ca. 1.2 mm longum, papillis elongatis curvatis obductum quae circum apicem annulum faciunt. Pappus nullus.

HOLOTYPE: Franklins Road above Hospital Creek near Kellevie, Tasmania - *D. & A. Ratkowsky and W. M. Curtis*, 19.xii.1973 (HO).

ISOTYPES: (K, Canb., Herb. Queen Victoria Museum Launceston).

A stiffly erect, much-branched shrub up to 2 m high, the branches arising in false whorls from beneath the previous years inflorescence; young branches, leaves and peduncles with a white tomentum which is hidden beneath a dense viscid yellow exudate. Young branches golden yellow. Leaves alternate, spreading or recurved, up to 2.5 cm long, narrow-linear, margins strongly recurved almost concealing the strongly tomentose lower surface; young leaves yellow-green, becoming dark green with age. Flower-heads numerous, shortly stalked, clustered in dense flattened corymbs terminal on upper branches. Involucre c. 5 mm long, cylindrical; phyllaries pale greenish-yellow, scarious; outermost ovate-lanceolate, obtuse, woolly hairy at the base, viscid; innermost with conspicuous radiating milky-white laminae c. half as long as the narrow-linear claw. Inflorescence-axis flattish, without scales; florets 4 - 5, hermaphrodite, equalling or slightly exceeding the involucre. Corolla yellowish-white, c. 3 mm long. Anthers tailed; style bulbous at the base, stigmas capitate, minutely papillose. Achene c. 1.2 mm long, covered with elongated curved papillae which form a ring around the apex. Pappus absent.

In November 1973 Dr. and Mrs. D. Ratkowsky discovered an undescribed species of *Compositae* growing in the vicinity of Hospital Creek near Kellevie. This plant closely resembles species of the genus *Ixodia* in floral and in vegetative characters although it lacks scales on the receptacle of the capitulum. It is therefore placed in the genus *Ixodia* with the specific epithet *achlaena* (without a cloak) referring to the absence of scales.

XYRIDACEAE

Xyris gracilis R.Br. subsp. *tasmanica* D. I. Morris, subsp. nov.
Xyris species "A" Evans, in *Contrib. N.S.W. Nat. Herb. 4 (1)*: 7 (1966)

Ex affinitate *X. gracilis* R.Br. subsp. *gracilis*, a quo sepalis lateralibus alis latioribus et carinis plus minusque prominentibus scabridiusculis, e basi ad apicem, differt.

HOLOTYPE: Blackmans Bay, 13 km south of Hobart, Tasmania - *W. M. Curtis*, 20.i.1952 (HO)

ISOTYPES: (K, Canb., Herb. Queen Victoria Museum Launceston)

A perennial resembling *X. operculata* but more slender. Leaves rigid, ±erect, 10 - 30 cm long, 0.8 - 2.0 mm broad; blade flattened laterally, thick, erect or sometimes tortuous, narrow-linear, apex tapered to an acute point, margin narrow-rounded, pale, serrulate; sheath brown, 2.5-4.0 cm long, ligule short, often emarginate. Scapes 30 - 50 cm long, slender, terete, rigid, often twisted, closely subtended by a twisted sheath 6 - 9 cm long having the

apex mucronate or aristate; the closely appressed next outer leaf having a sheath channelled along the inner surface, the channel bounded by scabrid keels, the blade reduced to a short point. Flower-heads usually ellipsoid or obovoid, sometimes ± globose, 5 - 8 mm long, the 2 or 3 lowermost bracts sometimes ± spreading, oblong with apex truncate or bluntly pointed, margin and apex ± torn, base shortly sheathing the peduncle; intermediate and upper bracts larger, broadly oblong-obovoid in outline with a central area hard, elliptic, usually paler in colour than the wings, wings entire or ± torn, apex usually emarginate. Flower with lateral sepals 5 - 6 mm long, keeled, keel scabridulous, wings broad, membranous, entire; median sepal very broadly obcordate. Petals pale to golden-yellow, lobes rounded, c. 5 mm broad. Stamens with anthers c. 1.5 mm long. Ovary 3-lobed, the apex not hardened.

Tasmanian plants formerly known as *Xyris gracilis* R.Br. have been shown to differ from *X. gracilis* R.Br. subsp. *gracilis* [O. D. Evans in *Contrib. N.S.W. Nat. Herb. 4 (1)*: 7(1966)] in having wider wings to the lateral sepals and in having a tetraploid chromosome number, 2n = 52 [B. G. Briggs, Chromosome numbers of some Australian Monocotyledons, *Contrib. N.S.W. Nat. Herb. 4 (1)*: 26 (1966)]. The subspecies *tasmanica* is now named to provide for the distinct Tasmanian populations.

GRAMINEAE

Danthonia pulvinorum D. I. Morris, sp. nov.

Gramen parvum glabrum caespiticium sub-alpinum,usque ad 12 cm altum. Folia basi culmi fasciculata, vaginis costatis; ligulae minutae, ciliatae, ad margines caespitibus pilorum longiorum; laminae usque ad 2 cm longas, arcte involutae, aciculares, arcuatae. Culmus rigidus, erectus. Inflorescentia 2 - 3 spicularum; omnes spiculae ca. 5.5 mm longae, 3 - 4 flosculorum quam glumis breviores. Glumae virides marginibus latis purpureis, inferior superiorem superans, late lanceolatae, obscure 3-nervatae. Corpus lemmatis obovatum, 9-nervatum, ca. 1.7 mm longum, callo brevi hirsuto, pilis sparsis minutis in serie inordinata super callum, vel cum vel sine caespitibus paucis pilorum, ca. 0.5 mm longorum, in serie sub sinu instructum; margines pilis candidis adpressis; lobi laterales ca. 1 mm longi, ad basim lati, ad apicem acutum curvati vel in setas usque ad 1 mm longas angustati, marginibus minute ciliatis; arista centralis ca. 3 mm longa, parte infera ca. 1 mm longa, mellea, semel torta. Palea lobos laterales lemmatis, sine setis, plus minusque aequans, oblanceolata, apice breviter emarginato; carinae minute denseque ciliatae, pilis paucis longis adpressis circa medium inter margines et carinas.

HOLOTYPE: Mother Lords Plains, north of Great Lake, Tasmania - *T. E. Burns*, 15.i.1969 (HO).

ISOTYPES: (K, CANB, Herb. Queen Victoria Museum Launceston).

A small tufted glabrous subalpine grass up to 12 cm high. Leaves clustered at the base of the culm, sheaths striate, ligule a minute ciliate rim with tufts of longer hairs at the margins; blades tightly inrolled, acicular, arcuate. Culm stiff, erect. Inflorescence consisting of 2 - 3 spikelets, each c. 5.5 mm long, the 3 - 4 florets shorter than the glumes. Glumes green with broad purplish margins, subequal, the lower slightly exceeding the upper, broad-lanceolate, obscurely 3-veined. Body of the lemma obovate, 9-veined, c. 1.7 mm long including the hairy callus, with a few minute hairs in an irregular row just above the callus and with or without a few tufts of hairs c. 0.5 mm long in a row just below the sinus, margins with appressed white hairs; lateral lobes c. 1 mm long, broad at the base, curving to an acute apex or ending in setae up to 1 mm long, margins minutely ciliate; central awn c. 3 mm long, the lower, flattened portion c. 1 mm long, golden brown, once twisted. Palea ± equalling the flattened portion of the lateral lobes of the lemma, oblanceolate, apex shortly emarginate, keels minutely and densely ciliate with a few long hairs between the margins and the keels at about the mid-point.

In January 1969, Mr. T. E. Burns collected on Mother Lords Plains, north of Great Lake, material of a small *Danthonia* which is now recognised as a new species. Because the specimens collected then, and subsequently, were all growing in cushions of either *Donatia novae-zelandiae* J. R. & G. Forst, or of *Abrotanella forsterioides* (Hook.f.) Hook.f.ex Benth. the new species is given the

epithet *pulvinorum* meaning "of the cushions".

Tetrarrhena oreophila D. I. Morris, sp. nov.

Gramen glabrum caespitosum, alpinum vel sub-alpinum, culmis erectis 5 - 15 cm altis. Folia maximam partem basalia; vaginae costatae, ad margines hyalinae, apices eorum pilis longis marginalibus; ligulae membranaceae; laminae 1 - 8 cm longae, rigidae, erectae, planae vel arcte involutae; laminae culmorum quam laminae basales parviores. Inflorescentia erecta racemum vel paniculam reductam formans, ramis pedunculisque brevibus scabrellis. Spiculae 4 - 6 mm longae. Glumae ovatae, 1 - 3 nervatae, hyalinae. Lemmata sterilia (inferius brevius quam superius), 3 - 5 nervata, lanceolata, indurata, scabridiuscula, apicibus eorum acutis vel apiculatis. Lemma fertile brevius quam lemma sterile superius, lateraliter compressum, 3 - nervatum, apice obtuso. Palea brevior quam lemma fertile. Antherae duae (vel aliquante una), 1.2 - 1.5 mm longae. Lodiculae 0.8 - 1 mm longae, suborbiculares.

A glabrous, tufted, subalpine grass, the culms erect, 5 - 15 cm high. Leaves mostly basal, sheaths ribbed, margins hyaline; ligules membranous with tufts of long hairs at the margins; blades stiff, tightly inrolled or flat, stem leaves smaller than basal leaves. Inflorescence erect, a raceme or reduced panicle, the branches and peduncles short, scabrid. Spikelets 4 - 6 mm long; glumes ovate, 1 - 3 - veined, hyaline; sterile lemmas lanceolate, indurated, minutely scaberulous, apices acute or acuminate, 3 - 5 - veined, the lower shorter than the upper; fertile lemma shorter than the upper sterile lemma, laterally compressed, 3 - veined, apex obtuse; palea shorter than the lemma. Anthers 2 or occasionally 1, 1.2 - 1.5 mm long. Lodicules suborbicular, 0.8 - 1.0 mm long.

Two distinct varieties are recognizable, viz.:

T. oreophila D. I. Morris var. *oreophila*

Laminae foliorum arcte involutae, 1 - 8 cm longae, pilis multis ad apices vaginarum; ligula ca. 1 mm longa, triangularis, marginibus minute laciniatis. Inflorescentia paniculata sed reducta, 2 - 3 cm longa, 2 spiculas quoque nodo ferens. Spiculae ca. 6 mm longae, gluma inferior ca. 1.8 mm longa, gluma superior ca. 2.2 mm longa; lemma sterile inferius 3 - 4 mm longum, superius ca. 4.5 mm longum, utrumque marginibus hyalinis et apicibus apiculatis; lemma fertile ca. 3.5 mm longum; palea ca. 2.5 mm longa. Antherae plerumque 2 sed aliquando 1.

HOLOTYPE: Tarn Shelf, Mount Field National Park, Tasmania - *D. I. Morris*, 17.ii.1975 (HO).

ISOTYPES: (K, CANB, MEL, Herb. Queen Victoria Museum Launceston).

Leaf-blades tightly inrolled, hairs at apex of sheath numerous; ligule c. 1 mm long, triangular, margin minutely laciniate. Inflorescence a reduced panicle 2 - 3 cm long, bearing 2 spikelets at each node. Spikelets c. 6 mm long; lower glume 1.8 mm long, upper 2.2 mm long; lower sterile lemma 3 - 4 mm long, upper 4 - 5 mm long, both with hyaline margins and apiculate apex; fertile lemma 3.5 mm long; palea 2.5 mm long. Anthers usually 2, occasionally 1.

Collected from Adamsons Peak and from the margins of lakes and tarns in the Hartz and Mount Field National Parks. The specimen from Adamsons Peak, collected by L. Rodway in 1894, has fertile florets with 1 stamen only. This material was mistakenly identified as, and mounted with, *Microlaena tasmanica*. The specimen is now recognised as belonging to a new species of *Tetrarrhena* which is given the specific epithet *oreophila* (lover of mountains).

T. oreophila var. *minor* D. I. Morris, var. nov.

Laminae foliorum planae, 1 - 3 cm longae, pilis paucis ad apices vaginarum; ligulae truncatae, ca. 0.5 mm longae, apicibus minute erosis. Inflorescentia racemiformis, 0.75 - 2 cm longa. Spiculae ca. 4 mm longae, gluma inferior ca. 0.8 mm longa, superior ca. 1.5 mm longa; lemma sterile inferius ca. 3 mm longum, superius ca. 3.5 mm longum, utrumque apicibus acutis; lemma fertile ca. 3 mm longum; palea c. 2.5 mm longa. Antherae 2.

HOLOTYPE: Lake Dobson, Mount Field National Park, Tasmania - *W. M. Curtis*, 6.i.1948 (HO).

ISOTYPES: (K, Herb. Queen Victoria Museum Launceston).

Leaf-blades flat, hairs at apex of sheath few; ligules truncate, 0.5 mm long, apex minutely erose. Inflorescence a spike-like raceme 0.75 - 2.0 cm long. Spikelets c. 4 mm long; lower glume 0.8 mm long, upper 1.5 mm long; lower sterile lemma 3 mm long, upper 3.5 mm long, both with apex acute; fertile lemma 3 mm long; palea 2.5 mm long.

Collected from the margins of Lake Esperance and Lake Dobson.

The author gratefully acknowledges the kind assistance of the collectors: Dr. D. A. and Mrs. A. V. Ratkowsky, Mr. T. E. Burns, Dr. W. M. Curtis, Mrs. J. E. S. Townrow and Mrs. M. P. Cameron and those who helped with taxonomic problems and discussion of the script: Dr. J. H. Willis, Melbourne, Dr. L. A. S. Johnson, New South Wales National Herbarium, Mr. John Lewis, British Museum (Natural History) and Mr. R. G. Hood, University of Tasmania. Thanks are also due to the Australian Biological Resources Study Interim Council for a grant in aid of field studies.

THE STRIGIPHILUS CURSITANS GROUP (PHTHIRAPTERA: INSECTA)

by

Theresa Clay

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ABSTRACT

A new species of *Strigiphilus* Mjöberg (Philopteridae) parasitic on the owl *Ninox novaeseelandiae* (Gmelin) is described and compared with other members of the *S. cursitans* (Nitzsch, 1861) species group. Notes on this group are included and *Eichlerius* Zlotorzycka and *S. glaucidii* Zlotorzycka are placed in synonymy.

Clay (1966) placed a number of species in the *cursitans* group having the following characters in common: tergum III without post-spiracular setae; male tergite VII not continuous across segment; ocular seta long; basal apodeme with central forked prolongation not fused to penis; female without well pigmented semi-circular sclerite anterior to opening of spermathecal tube. Within this group there are a number of taxa with characteristic external genitalia as shown for *cursitans* in Clay (1966), fig. 27 and in text-figs.3-8. Populations belonging to the *cursitans* group have been given names as shown in Clay (1966) but there is insufficient material available to decide on the status of all these names. However, it is possible to say that the populations from *Ninox novaeseelandiae* are separable and are here described as new.

The characters of importance in separating the taxa in this group are the shape and size of the head, the form of its anterior plate and the shape of the anterior margin of the dorsal plate of the male copulatory apparatus. The forked prolongation of the basal apodeme, the penal arms and the penis are liable to so much distortion in mounted specimens that they are of doubtful value as taxonomic characters. The sclerotization and pigmentation associated with the opening of the spermathecal duct is slight, difficult to see and shows individual variation depending perhaps on preparation techniques. Carriker (1966) mentions a "thickened, spine-like rod attached near the end, on the inside of tibiae 2 and 3"; it is not clear what is meant by this. If it is the structure shown in this position in his figures (e.g. fig. 18) then it appears to be one of the stout tibial setae probably found in some form throughout the Ischnocera and which cannot be used as a generic character in *Strigiphilus*.

Strigiphilus vapidus sp. n.
(Text-figs. 1,3,5,6,8)
Type host: *Ninox novaeseelandiae ocellata* (Bonaparte, 1850)

This species is distinguished from other members of the *cursitans* group by the proportions of the anterior plate and the details of the male genitalia. It resembles most closely *cursitans* (Nitzsch) and *touleskovi* Balat.

Description: General characters as shown for *senegalensis* in Tendeiro (1963). Size and proportions of head as in *cursitans* (see below under Dimensions), with some differences in the form of the anterior plate (text-figs. 1-2). Pterothoracic trichobothrium lateral and its associated spiniform seta near the latero-posterior group of seta; posterior setae: 2 + 3--3 + 2 or 2 + 4--4 + 2 with occasional

asymmetry of one seta in these groups. Mesosternal setae 2-3; metasternal setae 3-5. Shape of abdomen as in *senegalensis*. Shape and size of pleurites in *Strigiphilus* show some individual variation probably due to the preparation of specimens, but in specimens which appear to show maximum width of the pleurites those of the new species are narrower than those of *cursitans* and *senegalensis*. Male genitalia similar to those of *cursitans* but differing in details (text-figs. 3-8).

Chaetotaxy of the Abdomen: This is similar in the related species mentioned above and the variation is such that it cannot be used for specific separation. It is given here for a male and female of the new species only. In the *cursitans* group and perhaps in all *Strigiphilus* species, the outer seta each end of the line of tergo-central setae on terga II-VIII is separated by a gap from the rest of the setae and has a larger alveolus; on terga IV-VII it is near and inner to the post-spiracular setae. These last setae are not included in the count of the tergal setae. Male, terga II, 15 with two anterocentraI; III, 18; IV, 20; V, 16; VI, 15; VII, 12; VIII, 8; IX, 3 + 3. Sterna: II, 9; III, 15; IV, 17; V, 14; VI, 10; VII, 1 + 1; VIII-IX, 4 + 3. Pleura (male and female): II, 0 + 0; III, 1 + 1 short and spiniform; IV, 1 + 1 medium length; V, 2 + 3; VI-VII, 4 + 4; VIII, 4 + 4, one each side being the trichobothrium; IX, 3 + 3. Female, terga: II, I6 with two anterocentrals; I11, 20; IV, 22; V, 18; VI, 18; VII, 14; VIII, 10; terminal segments, 2 + 2. Sterna: II, 8; III, 16; IV, 19; V, 16; VI, 14; VII, 4. Setae at base of terminal sternite vary from 4-6 each side, mean 5.15.

Dimensions (in mm.): Temple width, ♂ 0.49-0.52, $\bar{X}$ 0.50 (11); ♀ 0.52-0.56, $\bar{X}$ 0.54 (10). Head length, ♂ 0.540-0.555, $\bar{X}$ 0.552 (11); ♀ 0.58-0.62, $\bar{X}$ 0.60 (I0). C.I. ♂ 0.89-0.94, $\bar{X}$ 0.91 (10); ♀ 0.87-0.92, $\bar{X}$ 0.90 (10). Pronotum width, ♂ 0.32; ♀ 0.34. Pteronotum width, ♂ 0.46; ♀ 0.50. Total length, ♂ 0.84; ♀ 0.96. Measurements of male head of *S. cursitans* from *Athene noctua*: Temple width, 0.46-0.51, $\bar{X}$ 0.49 (10); head length, 0.51-0.55, $\bar{X}$ 0.53 (10); C.I. 0.89-0.93, $\bar{X}$ 0.91 (10). Head length and total length in both species does not include the hyaline margin.

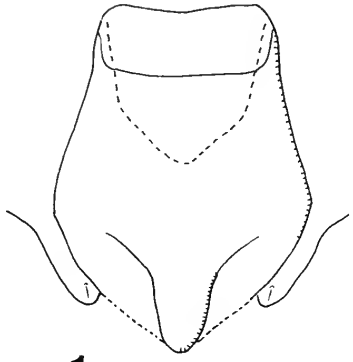
Material examined: Australia: 11 ♂, 10 ♀ from *Ninox novaeseelandiae ocellata* (Bonaparte), 20 miles E.S.E. of Agandys Hill, Pine Creek, Northern Territory, 25.viii.1968 (Harold Hall Expedition, BMNH). 5 ♂, 8 ♀ from *Ninox n. marmorata* (Gould), Perth, Western Australia, dates various (R. H. Stranger). 3 ♂, 1 ♀ from *Ninox n. leucopsis* (Gould), Rosevears, Tasmania, 5.ix.1965 (2 ♂) (R. H. Green); Flinders Island, Tasmania, 27.v.1971 (1 ♂, 1 ♀) (R. H. Green). New Zealand: 6 ♂, 4 ♀ from *Ninox n. venatica* (Peale), Wellington, 18.vi.1922 (E. Atkinson). 3 ♂, 3 ♀ from *Ninox n. novaeseelandiae* (Gmelin), Mt. Bruce, South Island, 6.ix.1971 (R. L. C. Pilgrim).

Holotype: Male in the Australian National Insect Collection from *Ninox novaeseelandiae ocellata* with data as given above.

Paratypes: 10 ♂ 10 ♀ with data as for holotype.

Notes on the *Strigiphilus cursitans* group

The *S. cursitans* group as restricted here contains all the species shown under this name in Clay (1966, p. 843) with the exception of *oculatus* (Rudow), *ceblebrachys* (Denny) and *speotyti* (Osborn) and with the addition of *S. acadicus* Emerson & Price, 1973; Ledger (1970) has figured the head of most of these species. In his paper Ledger has pointed out (p. 124) that the species *oculatus, ceblebrachys* and *zumpti* Ledger form a distinctive group and are better not included in the *cursitans* group. It is difficult, however, to see the advantage of the erection of the new subgenus *Eichlerius* Zlotorzycka, 1974 on morphological or any other grounds. The type species is *cursor* of the *cursor* species group (see Clay 1966, p. 841) and included in it are species belonging to the *cursitans* group *sens. str.* together with *heterogenitalis* Emerson & Elbel, belonging to the distinctive *macrogenitalis* species group. As there appears to be no advantage in giving the *cursor* species group a separate name,



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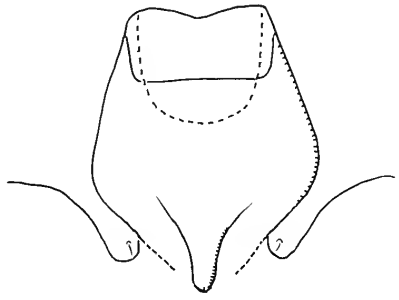

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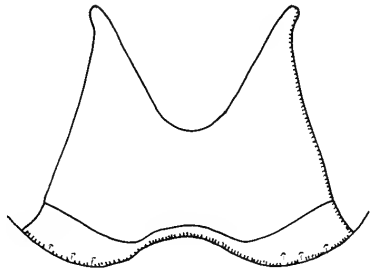

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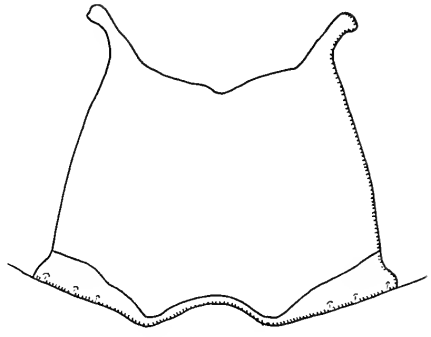

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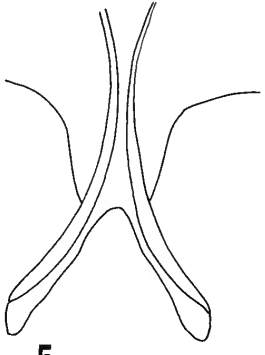

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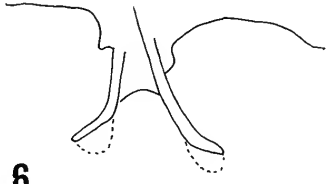

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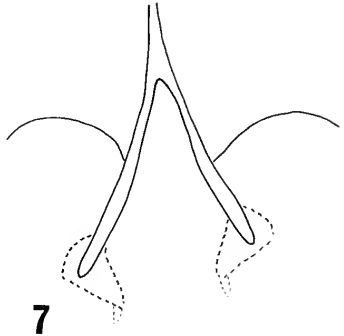

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8

TEXT-FIGURES 1 - 8

Text-figs. 1-2. Anterior plate. 1. *Strigiphilus vapidus* sp. n. 2. *S. cursitans* from *Athene noctua vidalii* Brehm. 3-8. Parts of male copulatory apparatus. 3-4. Dorsal plate. 3. *S. vapidus*. 4. *S. cursitans*. 5-7. Prolongation of basal apodome. 5-6. *S. vapidus*. 6. showing distortion. 7. *S. cursitans*. 8. *S. vapidus*, mesosome.

Eichlerius can be considered as a synonym of *Strigiphilus*.

Carricker (1966) described a number of species of *Strigiphilus* from New World owls of which those listed below probably belong to the *cursitans sens. lat.* species group; however, without an examination of the type material it is not possible to be certain of their status: *eleutus, perspicillatus, crucegerus, minimus, microgenitalis, jardini, speotyti altiplanus, s. desertae, s. magdalenae*. The following are unplaceable without an examination of the types: *lophostrix, heterurus* and *chilensis*.

Strigiphilus splendens (Giebel, 1874)

It is not clear why Zlotorzycka (1974, p. 337) describes a new species of the *cursitans* species group (*S. glaucidii*) from the type host of *splendens*. The specimen seen by Zlotorzycka from the type host and assumed to be *splendens* is said to be similar to *ceblebrachys*, but a comparison of the descriptions in Giebel of *ceblebrachys* (1874, p. 77) and of *splendens* (*ibid*, p. 79) shows that the latter could not be applied to the specimens seen by Zlotorzycka. Given the kind of descriptions of Giebel's date there seems to be no reason why the description of *splendens* should not be interpreted as that of a specimen belonging to the *cursitans* group; *glaucidii* thus becomes a synonym of *splendens*.

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THE INTRODUCTION OF FULLY TRAINED NURSES TO THE HOBART TOWN GENERAL HOSPITAL ON 20 JANUARY 1876

by

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ABSTRACT

The introduction of professional medical nursing services to Australia is described, with special reference to Hobart.

FORWARD

A friend, Mrs. Ellen Sweet, a member of the Australian Trained Nurses' Association who trained at the Royal Hobart Hospital, recently spoke to me of the coming Centenary of the introduction of fully trained nurses to Tasmania, with the consequent reorganisation of the nursing staff at the old Hobart Town General Hospital. The Anniversary was to occur on 12 February 1976 and I was asked if I could tell her anything about the conditions leading up to this epoch making event in the Hospital's history.

I promised to provide the required information for her and the nursing profession and was to find gathering it a most interesting as well as, at times, difficult task.

A Sub-Committee of Nursing Sisters under the leadership of Miss Donnelly (Lady Superintendent) had already (25 August 1975) produced and published an excellent illustrated description of nurses and their conditions during this period at the Hobart General Hospital, as well as in its subsequent 100 years. My contribution will therefore only describe certain of the principal factors that led to the introduction of fully trained nurses to Sydney and, in sequence, to the Hobart General Hospital.

The keys to a fuller understanding of these changes were the devotion, courage and determination of three notable women. Two from England and the third a young Tasmanian woman, they were worlds apart geographically but were all three pre-eminently very able and practical and equal to the tasks they set themselves. The first was the immortal Florence Nightingale (1820-1910); the second, her trainee Miss Lucy Osburn; and the third, Miss Florence Marie Abbott (1849-1935?) of Hobart Town. It is fitting here to give an outline of their qualities and accomplishments during the quarter century (1850-1876) when they accomplished so much. Included, also, is a brief description of the old Hobart Town General Hospital, of the conditions there and at the Sydney Infirmary within the period under consideration. The overseas Institutions concerned vitally were the Nightingale School of Nursing at St. Thomas' Hospital, London; the Sydney Infirmary (later the Sydney Hospital), then in Macquarie Street, Sydney; and lastly the General (now Royal Hobart) Hospital. In the final decade of the century, later Matron of the Great, Brompton Hospital for Chests at London, Miss F. M. Abbott, a young Tasmanian woman also plays her considerable part.

FOOTNOTE

This paper was prepared for the Annual Meeting of the Royal Australasian College of Physicians in Launceston in October 1975 but was not delivered owing to ill-health.

Miss Florence Nightingale came of a well established County family of considerable means; it was her fate to have in her nature a dominant strain of Philanthropy. This led her to undertake travels on the Continent, mainly in France and Germany, to master their languages and to study their Institutions caring for "the sick, infirm and aged". She had also the good fortune to have influential friends, especially Mr. Sydney Herbert (*q.v.*).

By mid-century (1853) Miss Nightingale had established an Institution in London for the care of elderly and infirm old ladies which she administered in person.

Again, early in the fifties of last century, Russia invaded Turkey. France and England, fearful of Russia's misuse of the Dardanelles, at once declared war. Their armies and men were soon on their way to the Crimean Peninsula in the Black Sea. The English fleet controlled the Baltic Sea as well as the Mediterranean. They had access to the Black Sea by their Turkish alliance. Very soon the English and French armies landed in the Crimea, fought the battle of the "Alma", and beseiged the powerful fortress at Sebastopol. The Russians resisted strongly and the many allied wounded and sick were taken by sea to Varna in Bulgaria, thence again by sea to a disused military barracks of the Turks, Scutari, near Constantinople. This old Turkish barracks had been converted by the British into a large hospital capable of housing 2000 sick and wounded men. It was found to be most unsuitable for use as a hospital, among other deficiencies, sanitation was almost non-existant. Rumours reached England of a bad break-down of administration, and Mr. (later Sir) Russell Howard, the "Times" correspondent, in due course sent lengthy reports to his Editor in London on conditions and medical care in the wards. This report in the "Times" disclosed a horrifying state of affairs. The wounded and sick, dirty and neglected, lying on the floors of straw, in their uniforms, the latter stained and stiff with blood and ordure. Added to this, there was little or no sanitation, an almost total absence of necessary Hospital utensils and, again, a break-down in supply of essential medicaments.

All this confusion and inefficiency was stressed by Mr. Russell Howard, who also pointed out these conditions were in marked contrast to those of our Allies, indeed the French military hospitals were well ordered and organised, and the envy of all ranks of the British army. The public reaction to the "Times" articles was tremendous and Mr. Herbert, then Secretary of State for War, discussed these terrible conditions with Miss Nightingale. Miss Nightingale, eager to help, volunteered at once to enrol women with some training to go with her to the Crimea and serve in the hospitals. Within a fortnight 60 ladies, including 10 Roman Catholic nursing sisters, were on their way to the "scene of war". Although certain high ranking Army officers did not welcome this startling feminine "takeover" (Miss Nightingale's official appointment was as "Lady Superintendent of the female division in the hospitals of the East") the sick and wounded received her and her helpers with rapture. The first reforms were with sanitation and cleaning. She was officially known as the "Lady in Charge" but is remembered as the "Lady of the Lamp".

Miss Nightingale recognised that the bad sanitary conditions had to be remedied first and the death rate of 42% in September was reduced to only 2% by the following June. The recurring assaults upon Sebastopol, apart from the wounded, brought about a terrific increase of casualties with frost bite and cold. Infestation by lice also was widespread and both Typhus and Typhoid Fever were rife. Cholera also played its part.

Miss Nightingale herself went on a brief visit to see conditions actually at the front on the Crimean Peninsula and became very ill. It is not known whether her condition was due to Typhoid or Cholera. Fortunately in due course she made a good recovery. She was to live until 1910, being ninety years of age when she died. With the cessation of hostilities, she arrived back in England by a French warship and the people of England lionized her and "took her completely to their hearts".

An autographed letter of thanks from Queen Victoria (and later a jewelled and enamelled brooch worked by Prince Albert himself) was presented to her when she visited the Queen at Balmoral.

A Fund to recognise the work of these ladies was started and rapidly topped £60,000. Miss Nightingale was unwilling to receive this sum personally but was delighted to agree to a suggestion to found a "Nurses Home" and school for nursing at St. Thomas' Hospital, London. She would not undertake its administration but for many years was in close touch with its Matron as its "Supervisor".

Out of the blue in 1857 came an appeal for her at her school at St. Thomas, to advise the Government of New South Wales, who were in difficulties. Such then was the international reputation of this wonderful woman.

In Macquarie Street, Sydney, the Legislative Council of N.S.W. and the Sydney Infirmary were situated side by side, in part sharing the same roof. The old Building having been the military hospital. The early Colonial building, established by Governor Macquarie, probably had a minimum of sanitation.

Parliament was in session that summer and Mr. Henry Parkes, Colonial Secretary, was gravely perturbed by the foul smells coming from the Infirmary, almost certainly caused by deficient lavatories and the open sewers. Added to this, the bodies and effects of the patients who probably were rarely washed or kept clean. The "nuisance" was so obnoxious and consistant as to actually hamper the business of the House and its political debates, so the Government of New South Wales instructed Mr. Parkes, as Colonial Secretary, to write to Miss Nightingale and seek her assistance, actually inviting her to come in person to the Colony.

In due course she replied and agreement was reached by which she would send a selected team of nurses to Sydney to reorganise the nursing and administration of the Infirmary. The agreement was to be for a term of three years and, at its termination, if desired, their return passages to London. The Matron of St. Thomas' Nursing School selected Miss Lucy Osburn and six senior nurses, the Misses Miller, Blundell, Chant, Turriff, Haldane and Barker.

There is ample official documentation of the work of these ladies. Their personal qualities with their interactions, flirtations and jealousies also have been recorded in an excellent article in the *Australian Medical Journal* of 1 May 1965, under the title of "Miss Lucy Osburn and her Nightingale Nurses", by Dr. M. P. Sussman.

This is extremely interesting and revealing but provides no clue as to what was done in regard to the smells of the Infirmary, which probably should have been referred to an architect or the Public Works Department. Miss Freda McDonnell's book, "Miss Lucy Osburn and her Nurses" should be compulsory reading for every Australian nursing graduate, describing poor Lucy Osburn, so young. and relatively inexperienced in comparison with her six head nurses. Miss McDonnell tells Miss Osburn's story in regard to the subsequent nursing problems and their difficulties. Many of these were recorded by the Royal Commission on the Infirmary at Sydney in its report.

Lucy never flinched in spite of only partial support from her Board of Management, and remained at the Sydney Infirmary (later the Sydney Hospital) from 1868 to 1884, in latter years serving as the Matron. She resigned in 1884 and returned at once to London, spending the remainder of her short nursing life working in England, principally in the slums of London, until she died in 1891.

The writer has seen no mention of a written report of Miss Osburn to the Government of New South Wales. It may well be that one exists in the Archives of New South Wales or at the Nightingale Home at St. Thomas' Hospital.

So far little has been said of conditions at the Old Hobart Town General Hospital, only recently taken over by the Colonial Government. It is proper at this stage to consider certain of the changes that were taking place during the 19th Century.

* * * * *

The coming of responsible Government to Tasmania in mid-nineteenth century had resulted in the withdrawal of British troops from the Colony and the transfer

from the Colonial Office in London to the new responsible Government those officials and the public buildings essential to the community. The old Colonial Hospital naturally was included. The transfer of these buildings to the new Government came automatically at the opening of 1860, but already, on 23 September 1858, a committee had been appointed by the Colonial Secretary at Hobart Town "to inquire into the State and Efficiency, of those Institutions for charitable usage, which had been hitherto supported or aided by the [Imperial] Government".

On 19 September 1859 the Hobart Town Gazette reported the appointment of a Board of Management, to administer the "General Hospital" and the "Brickfields" establishment for paupers. Actually, since the early eighteen-twenties, "The Colonial Hospital" had been situated on the site of the present Royal Hobart Hospital. The old freestone two storey building erected about 1827 having, after almost a century of service, been demolished in 1921 and the present Royal Hobart Hospital complex commenced on its site.

As remembered by the present writer (then a Medical student) in 1903, the old building was a fine solid freestone structure, with wide verandahs on the front northern aspect. It contained four large wards on both floors with lavatories and baths at hand at the rear. The back of the wards on both floors were "glassed in" which enabled the convalescent patients to be served with their meals from large Huon Pine tables, whilst sitting on movable wooden forms. Here, too, the utensils were washed up and dried. The sisters of each ward had a small office, but the staff nurses and nurses had neither privacy nor comfort until their hours of duty were over and they returned to the Nurses Home.

The lavatories made their location obvious but, with the installation of sewers, they were not quite such a nuisance. Full surgical sterilisation or Asepsis were only available in the operating theatre.

Many of the ward utensils then in use were made of pewter and on the dressing trays all basins and flat trays were of this metal. Memory does not record, but I seem to remember at this period, hot water being laid on to any hand basins in the wards. In these years, there was always a seasonal epidemic of Typhoid Fever, requiring special wards for both sexes.

On 1 January 1860, when the Colonial Government took over, the hospital site was ample — with the one big building and a dispensary. Its hospital administration and offices were clustered around the old original brick hospital, some 300 yards away on the southern boundary of the site. At the time of the transfer, this building was still overlooking the town rivulet and harbour and housed the dispensary with portion of the Administrative quarters, as well as staff offices and the nurses' dining room. It is probable also that it accomodated certain of the female patients, in fact, it was still termed the "old female hospital" at this time.

In the hospital all the patients were classified as (1) male patients, (2) male invalids who were ranked as patients, (3) female patients in the building at the back, (4) female invalids ranking as patients and (5) females and children of tender age.

The staff at the time of the takeover consisted of a House Surgeon (Dr. G. Washington Turnley, salary not disclosed), a medical clerk (Mr. John F. Cox at £150 p.a.), Mr. Charles Seager, Superintendent of male patients (£156), Matron (Mrs. Peel, possibly wife of an overseer at £125), Dispenser (Mr. John Seale at £91.5.0), two Gatekeepers receiving £77.7.6 each, a Messenger £79.7.6, assistant at medical stores at £90.10.0, and the Tailor, Messenger, Baker, Cook, Gardener, Watchman, 6 nurses (female) and a female Cook and Laundress each receiving 2/- a day. The number of wardsmen was not given.

On 19 December 1859 there appeared in the "Hobart Town Gazette" the names of ten gentlemen to "constitute a Board of Management for the sick and invalid departments belonging to the medical department of the Government at Hobart". In the course of December and early in January, four more names were added including the then Colonial Secretary and the Mayor of Hobart.

During the next 20 years, four Honorary Medical officers Drs. H. Butler, W. L. Crowther, Doughty and T. C. Smart, effected many improvements in the hospital. Dr. Smart as Chairman of the Hospital Board for the long period of 27 years was responsible for radical improvements, including new Officers' quarters, enlarging the Dispensary, reconstruction of bathrooms and sanitary arrangements; and the laying of piped gas and water services. His great services are commemorated by a fine brass Tablet in the main foyer of the hospital. He died 26 March 1896.

Although material improvements were made at the hospital during its first fifty years, as a whole it had remained stagnant and old fashioned. Nevertheless vital changes were stirring in the community, influenced by advances in sanitation and medical thought overseas. Drastic changes were obvious in the United Kingdom, especially in urban sanitation. This applied especially to the crowded streets and habitations in the cities following the Industrial Revolution.

The streets and houses generally were divided into terraces and, although large families were the rule, often only one privy was shared between two houses "situated back to back".

At Hobart the houses of city residents, with few exceptions, were dependent on the removal of the pans of galvanised iron during the night by heavy black horsedrawn waggons. The collected pans were then loaded on a river steamer, which took this cargo down the estuary of the Derwent inside the "Iron Pot" lighthouse, where it was either landed for use by the farmers or poured over the side from the individual pans which were then sluced with water and given a lining of liquid tar before going into circulation again.

At the turn of the century, Dr. Gregory Sprott, M.D. (Glasgow), became a Resident Surgeon at the hospital. He afterwards went into private practice, becoming a "City Health Officer". By persistant efforts, he educated and persuaded the City Council to institute the Metropolitan Drainage Scheme and by this means all residences became sewered and immediate improvement followed. Fly-borne Typhoid Fever, always endemic and each late summer, epidemic, became less and less, as did much other fly-borne diseases which now are very rarely seen.

Again, by this time there were two infant Medical Schools at the Melbourne and Sydney Universities, where the medical students were made well aware of these essential changes and canvassed for them.

Altogether the general public were becoming more aware of disease and its causes and prevention. The arrival in 1868 of Miss Osburn's Young Ladies and their reforms at the Sydney Infirmary would be fully known in Hobart, and obviously created widespread dissatisfaction in the organisation and administration of our own hospitals.

There were, as it chanced, two young Tasmanians who were aware of the pressing need for radical changes in the nursing organisation and staffing of the two principal hospitals of Tasmania and possessing the ability and vocation to improve matters.

Firstly Florence Marie Abbott (1847-1935), then approaching maturity, with a definite vocation to devote herself to the nursing and care of the sick and who had already resolved to study under Miss Lucy Osburn at Sydney.

Secondly, George Washington Turnley M.R.C.S., Resident Surgeon Superintendent of the Hobart General Hospital who was born in the U.S.A. near 1800 and arrived in Van Diemen's Land with his parents and two siblings by the ship "Lord Rodney" in 1825. Possibly his father returned to the U.S.A. It is known George Washington in his late youth and early manhood became a sailor and adventurer and he was also believed to have had a spell as a gold digger in California or Victoria, or possibly in both places.

In 1855, he gained his Diploma M.R.C.S. England and on 26 November of the same year, registered his qualifications in Tasmania and commenced practice. He held no appointment in the Colonial medical system until appointed as a Resident Surgeon to the Hobart General Hospital from 1860 to 1866. This was

followed by a similar appointment as Surgeon Superintendent of the Launceston General Hospital from 1867 to 1869. A re-appointment as Surgeon Superintendent at the Hobart General Hospital followed in 1870 and continued until 1877, when he became Medical Officer to the Government Establishments for Paupers and the Queen's Asylum, now St. John's Park, New Town.

Thus he gained wide experience in hospital administration, especially in the two principal Tasmanian hospitals. He was very soon to find cause for dissatisfaction.

As Surgeon Superintendent at Hobart, he found in the early eighteen seventies its nursing personnel were 16 in number, 10 males and 6 females. The Matron, Mrs. Peel, was concerned with the nursing of the female patients and infants. Mr. Seager was responsible for the four male wards and the male nursing staff. Very soon Dr. Turnley began finding considerable difficulty in obtaining wardsmen to train in nursing duties and finally drew the attention of the Colonial Secretary to his wants and consequent difficulty in staffing the Institution. This essential need does not seem to have been referred to the Board of Management, nor apparently had Mrs. Peel been approached on the matter.

In the early eighteen eighties, the new freestone buildings of a female hospital were erected; and only recently have been demolished. The transfer of male patients in 1921 to the Royal Hobart Hospital main block followed. The old building had been invaluable at times of great emergency, notably during the Second World War, when it accomodated service personnel not eligible for Repatriation and A.I.F. benefits.

It is sad but true that, throughout its long existence, the hospital seems to have been the sport and victim of both parties during parliamentary sessions. It was used, if possible, to discredit the then Government by disclosures of neglect or other irregularities. Through the decades the long reports of parliamentary committees and Royal Commissions have been printed, inquiring into allegations of faulty treatment and the errors and omissions of the staff, but it was rarely that action was seen to have been taken when such accusations were confirmed. Indeed, many of the complaints were of minor significance but useful for political issues.

However, during the period now under consideration between 1850 and 1875, the functioning of the hospital seems to have been relatively stable. With the change of administration on 1 January 1860, a Board of Management became responsible and for 20 years the hospital seems to have been reasonably well controlled and the organisation on the whole improved.

Dr. T. C. Smart, Chairman of the Board, reorganised the old original hospital buildings at the southern end of the grounds as female wards and offices for staff. Again during his administration, a bequest enabled the provision of a modern operating theatre with facilities for sterilising for general hospital purposes.

Dr. Smart must have seen the completion of the splendid large freestone female hospital at the southern end, and also the Nurses Home, facing Argyle Street, now demolished and replaced by a large Obstetrics and Gynecological Department. For a while in this period some of the female patients were housed in premises on the other side of Liverpool Street; later they vacated this location which became the police court. For a while, I understand the night staff went there for quiet rest. Further development made construction of a new Nurses Home on the hospital site essential and the fine new building facing Campbell Street now serves all their purposes.

Somehow we have digressed from consideration of the pressing needs of Dr. Turnley, and his lack of wardsmen, and his writing to the Colonial Secretary for assistance. Fortunately for all concerned, the Colonial Secretary knew where to look for support – remembering Miss Florence Abbott, then nearly twenty, the accomplished daughter of his colleague, Major Edward Abbott (formerly Deputy Judge Advocate General on the staff of the Lieut. Governor Davey of the Royal Marines). Miss Abbott who was then nursing privately in Sydney had a vocation for nursing, having studied in the Sydney Infirmary under

Miss Lucy Osburn. She (Miss Abbott) was invited by the Colonial Secretary to come with a team of trained nurses from Sydney and take the position of the first Lady Superintendent of the hospital. To effect this he sent a member of his staff to approach Miss Abbott on the matter. That lady expressed her interest – sent her testimonials from prominent Sydney medical men and wrote a letter of conditions which would have to be met (Appendix 1) before she would accept the responsibility offered to her.

Also, she drew the attention of the Colonial Secretary to the conditions of engagement of the four Sydney ladies – the Tasmanian Government proposed that Miss Abbott should have a saloon passage to Hobart Town on "S. S. Tasmania" while the nurses, the Misses Laura, Fanny and Rosamund Holder and Miss Mary Gordon, were to travel steerage. This matter was at once adjusted and Miss Abbott arrived in Hobart on 23 December by the "S. S. Tasmania" while her nurses followed as cabin passengers on 14 and 21 January 1876. The final agreement with the Colonial Secretary was that the system of female nursing should begin early in 1876 with Miss Abbott bringing four trained nurses with her. Her salary to be £80 p.a. with free quarters, light and rations, and additional young Tasmanian women to be engaged to undergo training. Such local girls were offered quarters, fuel, light and rations with a salary of £36.10.0 p.a. These conditions it was presumed would attract local young ladies to apply to be trained. Such local engagements were to be for 12 months.

Actually conditions at the hospital were such that before the end of January, Miss Abbott was expressing doubt as to whether she could carry out her duties with fairness to herself, as apparently she was expected to administer only the lower wards, leaving the four male wards upstairs to be managed independently of herself. Her relations with Mr. Seager who controlled the male wards upstairs, appear to have become and remained very strained.

From time to time in this narrative, allusion has been made to Miss Florence Abbott's abilities. Whilst the broad outline of her career is known, one can find very little in regard to her youth and education. Certainly we are well aware of the careers of her immediate family. The present writer did have opportunities as, on two occasions, Miss Deighton, her lifelong friend, visited Hobart. Contact was made with her, but she was only questioned on Major Edward Abbott's (her father's) career. The other opportunity was when old Mrs. Thomas Hopkins, herself a member of Miss Abbott's nursing staff, was my patient. At that time I had no idea of Miss Abbott's career after leaving Hobart Town and so her memories were not obtained. So in what follows I can be certain only of the dates of her appointments and services in later life. One can only guess at her education, her early friends and their influence.

MISS FLORENCE MARIE ABBOTT

On 20 July 1849 Florence Marie Abbott was born to William and Georgina Abbott (neé Bilton) at Hobart Town.

Her arrival at Hobart Town from Sydney toward the middle of 1875 with six fully trained nurses to reorganise the nursing staff at the Hobart General Hospital was the climax of her long and distinguished career in nursing. She died in England about 1935, having played a brilliant part in this local drama; but we know little of her personal life and attributes. A great deal has to be inferred or even guessed.

We may however consider certain facts that influenced her toward the life of a professional nurse and career of arduous service to the community. Certainly she came of good stock; her grandfather Major Edward Abbott, born in the West Indies, was commissioned to the 34th Regiment, but later transferred to the 104th or N.S.W. Regiment – known to the long suffering residents of New South Wales as the "Rum Corps". He was of high character and studious habits and in 1812 was posted to Hobart Town as Deputy Judge Advocate General to Colonel Thomas Davey R.M., Lt. Governor of Van Diemen's Land. His son William was born at Hobart Town on 5 May 1826 and married Georgina Bilton at St. Peter's Church, Hamilton, on 29 October 1846. From this union Florence Marie was born on 20 July 1849.

PLATE 1 Miss Lucy Osburn, Lady Superintendent, Sydney Infirmary (later Hospital) - 1868-1884.

PLATE 2 The Sydney Infirmary, 1870
by courtesy of the Library of the Royal Australasian College of Physicians, Sydney.

I have been able to discuss her younger years lately with her very distant cousin, Mrs. Knight of Hobart, but she cannot tell me anything of her early education nor have I been able to trace any portrait likeness to her except in nursing groups at Sydney.

In a very recently published commemorative book issued by a small committee under the present Lady Superintendent (Miss Donnelly) of the Royal Hobart Hospital, two contemporary photographs are reproduced, one a very striking one of a group of nurses and two Resident House Surgeons of the Royal Hobart Hospital during her regime 1876-81, Mrs. Hopkins being in the group. The other a portrait of herself in her uniform as a Head nurse or Sister, possibly taken at Sydney a little before the same period.

It must be assumed that, with her grandfather's military status and her family's pastoral relations (three of her aunts had married into early Colonial families of Van Diemen's Land), she would have had sufficient knowledge and a certain share of what social and intellectual life the Colony afforded.

Actually, the late Professor E. Morris Miller, with whom the writer was on close personal terms, on several occasions emphasised in his conversation, his firm opinion that, during the period before mid-century in Van Diemen's Land, the standards of literary and scientific thought and writing and of the Press were of a very much higher distinction than those of the neighbouring Colonies. He based his opinions on his professional studies of writings and of the Press while compiling his great work on the Bibliography of Australia. It is proper to assume Miss Abbott had good manners and a good education and "grew up" in circles and a home in which affairs of the old world, and especially in closer Sydney, would be very much discussed when the occasional delivery of mails or travellers brought news of outstanding events, discoveries and developments.

Undoubtedly the small isolated community in V.D.L. followed with intense interest the arrival of belated news when England and her allies were engaged desperately with the Russian army at the Crimea. Equally, as some little comfort, they would learn of the wonderful work of Miss Florence Nightingale and her team of volunteers who were striving to bring comfort, cleanliness and hope to the wounded and sick in extemporised hospitals at Scutari and elsewhere.

When Florence Abbott was 19 years old in 1868, and Miss Osburn and her team arrived, she was early aware of its significance. She made up her mind, possibly actively discouraged by her relations and friends, that she would proceed to Sydney and study the new profession of nursing under Miss Lucy Osburn. Miss Deighton stressed that Florence had long made up her mind but in fact did not join Miss Osburn at the Sydney Infirmary until 1871.

It must be stressed here that the exponents of female nursing in Australia at this time were much the same tough types from the penal colony as their male counterparts. From their origin it followed that they possessed very little education, no special training and with no vocation for this career.

Florence Abbott came from a well disciplined home and was accustomed to exert authority.

Such then was her life in Hobart Town. During 1867 and 1868 no doubt the arrival of the nurses at Sydney was discussed in her circle eagerly and fully in all its aspects.

But five years were to pass before she moved to Sydney and on 4 July 1873 she was accepted as a Probationer. It may be assumed that her immediate family were in no way co-operative and any permission to enrol for the course of nursing would, in the first place, possibly have to be from the office of the Colonial Secretary at Hobart Town, the Hon. T. S. Chapman or his successor. What we do know is that, on 5 July 1873 she was accepted as a Probationer at the Sydney Infirmary at a "wage" of £20 p.a. An interview would no doubt have been required.

She was officially described as aged 24 and it is stated she was born in Tasmania, that her mother had remarried and was living in New Zealand. In the words of this questionnaire, she seems to have been interested in private nursing whilst in Hobart, thus following the example of Miss Nightingale. She is noted also as being a second cousin of W. Fortescue, a prominent medical man then practising in Sydney. Her religion is given as Church of England with a note of reserve. Did Miss Osburn herself a fervent Anglican, so early suspect that her pupil, Miss Abbott, was not deeply religious and lacked faith.

Florence now removed from her family, was perhaps becoming homesick and almost certainly overworked. It has seemed to me as House Surgeon at two hospitals that Probationers must in almost all instances be depressed at the variety, and disgusted at the nature, of some of the many menial duties to which they are directed.

Her whole hospital years show her to have been individualistic, high spirited and fond of company. So with various ups and downs, her nursing training went on until March of 1875 (perhaps a month sooner than usual) and a decision was made that she was not suitable for the duties of a Sister. My own feeling is that she and Miss Osburn were uncompatable.

A visit home to Tasmania followed in 14 March. Three weeks later she returned to Sydney and engaged in private nursing.

She must have impressed Hobart Town on that brief visit to her home for, as has been written, it will be remembered that Dr. G. W. Turnley was in difficulties with his staff. Be this as it may, it is history that the way was open for the claim of Florence to be appointed Matron to the Hobart Town Hospital, factors to be weighed by the Colonial Secretary and for him to decide to use his influence to help her.

The keeper of the nursing records at the Sydney Hospital at this period, noting this appointment, states "she (Miss Abbott) asked many of my nurses to go with her but none would". She was wrong, four of the nurses at the Sydney Hospital did accept Miss Abbott's proposals. It is only proper here to record the names of these ladies who accepted and came with her to the Hobart General Hospital, viz. the Misses Laura, Fanny and Rosamund Holder and Miss Mary Gordon.

Previously the then Colonial Secretary, the Honourable T. D. Chapman, eager to embody Dr. Turnley's recommendations, may well have discussed terms with Miss Abbott who was on holiday at Hobart Town.

This lady then laid down in black and white (Appendix A) the essential conditions under which she would agree to become Matron of the hospital. These provided for her complete control of the nurses and the numbers and rank of the nursing staff, their salaries, uniforms, etc. Also, that she alone was to be responsible to the Board for the control of her probationers and nurses and sisters.

After settling in, conditions at the hospital were found very unsatisfactory and, in January 1876, Miss Abbott complained to the Colonial Secretary that she "doubted" whether she could do justice to herself and the hospital by undertaking the management of the lower wards only, leaving the upper male wards to be managed independently of her staff.

The report of the Royal Commission of 23 January 1877 gives ample evidence of her dislike of Mr. Seager, who apparently was responsible for the nursing and care of the patients in the upper male wards of the main building. She controlled only the lower wards for females. She laboured and endured at the General Hospital for a little over five years in all.

Her decision was then made to proceed to England and take a hospital appointment there. In the United Kingdom, we may picture her welcomed by the relations of both her grandfathers and her grandmothers, of good service families and with influence; for surely she would need plenty of that to ensure her success when in London she applied with "many others" for the vacant position of Matron of the Great Brompton Hospital for Chests in London. An

inquiry by my friend Professor Bryan Gandevia for information of her years there indicate that they were without any notable difficulties or incidents.

Miss Abbott was appointed Matron of the Brompton Hospital from 14 applicants for the position. She held the post for some years and eventually married Dr. Taylor, who was several years younger than herself. They lost two children in infancy but when she left the hospital she adopted two children. During the First World War, she bought some cottages near her own home in Jervis Close, Steyning, Sussex and took in orphans and other children needing shelter and care as the result of the war. She maintained this work until she was too old to continue. Miss Deighton visited her in 1929 and in 1930 Florence Abbott sent the last of her orphans, then aged 11, to Miss Deighton who had returned to Australia.

This child, now married, lives in Hobart but her address is not known. Miss Abbott died in 1935-36 aged about 85.

Miss Deighton also died about 1974 and so much of this section is conjectural rather than factual, lacking the information she could have given.

We have followed the principals that brought the profession of nursing to Tasmania and the characters and difficulties of the four personalities concerned. All four served their country well but for the foundation of this vital knowledge in Tasmania, we are endebted to Miss Florence Marie Abbott, whose work should rank only in lesser degree with the accomplishments of Miss Nightingale and Miss Osburn. Some memorial to Miss Abbott and her services should be afforded to her in this state and her attainments thus remembered and appreciated by succeeding generations of fully trained nurses and the country as a whole.

* * * * *

It is pleasing to add that the very high standards of nursing acquired and maintained by the graduates from the Royal Hobart Hospital has been more than maintained by Miss F. M. Abbott's distinguished successors as Lady Superintendent, viz.

Matron Miss Harriett Munro	Lady Superintendent	1887-1896
Matron Johnston Turnbull	Lady Superintendent	1896-1917
Matron A. A. Gluyas	Lady Superintendent	1917-1931
Matron Gladys Lade	Lady Superintendent	1931-1935
Matron M. McGrath	Lady Superintendent	1935-1938
Matron Ruth Cockayne	Lady Superintendent	1938-1946
Matron Jean O. Brown	Lady Superintendent	1946-1963
Matron Daphne Hill	Lady Superintendent	1963-1966
Matron Miss P. G. Donnelly	Lady Superintendent	1966-

APPENDIX 1

A letter from Miss Florence M. Abbott, dated 7 April 1875, to the Hon. T.S. Chapman, M.H.A., Chief Secretary, relating to his invitation to her to accept the proposed position of the first Lady Superintendent of the Hobart General Hospital.

With this Miss Abbott enclosed copies of testimonials from leading Sydney medical men (also reproduced).

She states the conditions in regard to the proposed nursing reorganisation, required to be met, before she feels she can accept this important and unique appointment.

* * * * *

Hobart Town
7 April 1875

I shall feel obliged by your looking over the enclosed letters - as I wish you to know, the opinion of some of the medical staff of the Sydney Hospital, as to my competency to superintend the management of the nursing arrangements of your hospital.

I have considered the offer you have made to me, of undertaking the superintendence of the nursing staff of the Hobart Town Hospital, and shall be happy to accept it under the following conditions.

That the Lady Superintendent has sold control over the nursing staff.

For the perfect order, cleanliness, and efficient working of the Hospital, the staff must consist of —

4 Head Nurses (This provides for night nursing
11 Probationers (
1 Wards man
1 Scrubber
1 Domestic servant
1 Needle woman - for cutting out and to assist in making the patients uniforms

The accomodation required for this use, to consist of —

Mess room - dormitories - bathroom and lavatory - kitchen - work room &c - with private room for the Lady Superintendent.

The ages of the Misses to be, not under 20 or over 40.

In making the new arrangement would especially urge the use of a uniform, both for the staff and patients. The comfort and cleanliness of the patients, and the general appearance of the Hospital, is much increased by this regulation.

I shall be ready to enter upon the duties of Lady Superintendent, when your arrangements are completed, which I understand will be some time in August.

I am prepared to engage from Sydney, 4 trained nurses to take the situations of Head Nurses — but until I have communicated with them, I do not feel at liberty to mention their names, ages &c — I shall be happy to communicate these particulars on my return to Sydney.

As I should insist upon their making an engagement for a year, all their expenses from Sydney, to Hobart Town, ought I think to be paid.

It is understood I believe that I have authority to offer £36.10 a year to each of the 4 Head Nurses.

Should any difficulty arise in engaging 11 Probationers here, I shall be happy to do my best in carrying out any instructions you may send me, for engaging them in Sydney.

I am Sir
Yours Obediently
Florence Abbott

The Colonial Secretary

Any letter to Miss Abbott to be addressed to the care of

Dean
Sydney
New South Wales

Testimonials received from Miss Florence Abbott.

No. 1

This is to certify that Miss Florence Abbott has been engaged as a probation sister in the Sydney Infirmary for the last two years, most of which time she has been in my ward.

I have had every reason to be satisfied with Miss Abbott's zeal, industry, and attention to her duties. She has always shown great kindness and humanity to the patients under her charge.

I understand that she desires an appointment in the Benevolent Asylum. For this I can strongly recommend her.

(signed) W. Maclaurin
M.D.

187 Macquarie Street
Sydney
March 4th 1875

No. 2

March 8th 1875

I have much pleasure in bearing testimony to the qualifications of my friend Miss Abbott as a Nurse. For nearly two years she has been acting as a Lady Nurse to the Sydney Infirmary, and during that time, I have had ample opportunity of forming a most favourable opinion of her skill and of her kindness and attention to the sick under her charge.

(signed) Walter W. Spencer
Honorary Surgeon
Sydney Infirmary

No. 3

It gives me great pleasure to bear testimony to the very superior acquirements of Miss Florence Abbott as a Nurse; I have had many opportunities of witnessing her career in that capacity in the Sydney Infirmary during the last two years, and I have been in every respect favourably impressed with the manner in which she performed her duties.

(signed) Charles K. MacKellar M.B.
Hon. Surgeon Sydney Infirmary

College Street
Sydney
17th March 1875

No. 4

March 14th 1875
Lyons Terrace
Sydney

Miss Florence Abbott has undergone for two years, a course of training as probationer and Nurse at the Sydney Infirmary where she has been under my immediate observation for most of that time. She has a good and cheerful disposition with unusual activity and intelligence; has had unusual opportunities for seeing Medical & Surgical practice and considerable experience in nursing cases of severe operation and injury. She is, I think, already a competent and trustworthy nurse, and is, I believe, sure by experience, to become thoroughly fit for any Office of control or direction in the profession to which she has devoted herself.

(signed) G. Fortescue M.B. London
Late Honorary Surgeon
Sydney Infirmary

No. 5

Sydney Infirmary
8th March 1875

I have much pleasure in expressing the high opinion I have formed of Miss Florence Abbott's ability and skill as a trained nurse. During two years that she has been under my constant observation at this Infirmary I have ever found her diligent and assiduous in the discharge of her duties, and kind and attentive to the patients under her care.

I can confidently recommend her as in every way competent to undertake not only the duties of a hospital or private nurse, but to superintend an entire ward and to acquit herself of its duties in a satisfactory manner.

(signed) L. F. Halket L.R.C.P.
London
House Surgeon

APPENDIX II

In our correspondence Professor Gandevia describes a booklet (not previously known to the writer) written by a Dr. Bowd on Lucy Osburn — "giving main centres where persons trained by her took charge, with dates". It reads thus:

1870	Mudgee	Shorter
1873	Farban Creek	Bland
1877	Orange	Davies
1879	Parramatta	Pearson
1880	Adelaide	Wilmott
1880	Children's, Glebe	Holden
1881	Brompton (?)	Abbot (sic)
1881	Hobart	Bland
1881	Launceston	Windred
1881	Bathurst	Keyes
1885	Ballarat	Rucher
1885	Young	Neyler

Dr. Gandevia (pers. comm).

"Sources of the above data not specifically stated — but it seems you might easily find reference to Abbott in Osburn's correspondence with Miss Nightingale."

This writer pleads want of mobility and distance as factors that did not allow him to follow this advice.

It seems at least impossible that the Great Brompton Hospital for Chests in London should have to wait until 1881 for Miss Abbott to introduce the new nursing standards. Again the credit in regard to Hobart is given to Nurse Bland in 1881. I hope that this narrative will ensure that Miss Florence Abbott will be given that credit as from January 1876 when, with her selected team, commenced the reorganisation of the old Hobart General Hospital.

Careful work in the various hospital records above, might disclose other inconsistancies in the priority claimed for these Trainees of Miss Osburn at the Sydney Hospital.

ACKNOWLEDGEMENTS

Mrs. Mary Gordon McRae, State Archivist, provided able assistance and Mrs. Mary Nichols, also of the Archives Department, has made a close study of the subjects of this paper. She produced Miss Freda MacDonnell's splendid study of "Miss Nightingale's Young Ladies", (Angus and Robertson, Sydney, 1970) which proved of unestimable value.

A similar debt is owed to Dr. M. P. Susman of Sydney for his paper on "Lucy Osburn and her Five Nightingale Nurses" in the Medical Journal of Australia, 1965 Vol. 1 pp. 634-648, whose study of the personalities of these ladies and their subsequent Australian careers is a notable contribution to medical history.

My friend Emeritus Professor Sir Edward Ford has also helped me from his long experience. Dr. Bryan Gandevia has greatly helped me in my search for data of Miss Abbott; while Mrs. Alison Holster of the Library of the Royal College of Physicians has been able to supply the essential dates and particulars of Miss Abbott's training years at the Sydney Infirmary.

In Hobart, Miss P. J. Donnelly, Lady Superintendent of the Royal Hobart Hospital, with Mrs. Mary Nichols kindly supplied me with material they had collected for their own excellent work, "The 100 years History of Nursing at the Hobart Hospital".

I have in my Collection an original mounted print of Miss F. Abbott with the nursing staff at the Hobart General Hospital. It was given to me some thirty years ago by my patient Mrs. Thomas Hopkins who was one of the nurses in the group. I lost the opportunity to ask the names of all the nurses nor did I ask for her personal estimation of Miss Abbott's standing in the eyes of her nursing staff.

Lastly, I must insert my tribute to Mrs. K. A. Walker who completed the notable task of typing my crabbed and minuscule handwriting. What I owe to her patience and kindness it would be extremely hard to describe or even estimate.

THE VERTEBRATE FAUNA OF MAGGS MOUNTAIN, TASMANIA

by

R. H. GREEN

Queen Victoria Museum, Launceston

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ABSTRACT

The vertebrate fauna in an area of Tasmanian highland forest are outlined with some observations on the initial effects of the clear-cut method of tree harvesting. Pathological data from material collected are included.

INTRODUCTION

Tasmania has extensive forest resources. Great areas have been logged selectively for sawlogs for one hundred years and the resultant forests are largely degraded. At most altitudes eucalypts regenerate hetter under a system of clear-falling where the growth of young trees is not inhibited by a residual forest canopy. Thus the continuance of commercially valuable forests at a maximum level is dependant upon the removal of most of the remaining canopy.

Since 1972 handsome financial returns have attracted a woodchip industry and a great proportion of the previously uncommercial forest now is being harvested for this purpose. Three major companies are extracting and exporting woodchips. Large financial investment has permitted the introduction of additional modern machinery and log handling equipment. Roads and processing plant have been developed to handle the increased volume. Forest management plans are well advanced and controlled cutting is being undertaken on government-owned land and some private areas.

The harvesting methods adopted and the greatly increased areas involved have created public dissension about the effects of such operations. The arguments for and against have been published and debated at length. Increased and recurrent forest usage which create financial profits are advanced on the one hand, while the dangers of creating an ecological imbalance and reducing aesthetic qualities, possibly beyond redemption, are alternatively argued.

Under the present silvicultural practice of limited compartment cutting and regeneration by slash, burn and manual re-seeding or planting with softwoods, the future forests will become principally a patchwork of even-aged stands. These will produce long-term timher crops to be harvested in rotation, in a somewhat similar system to many of the intensive farming units now producing grain, fruit or meat on land which once supported fine eucalypt forests.

The long-term effects upon the ecosystem as harvesting continues and its effects expand cannot be predicted. Undoubtedly, there will be many problems, both silviculturally and zoologically, as harvesting proceeds on such a scale. Animal survival is primarily dependent upon three requirements: food, shelter and breeding conditions. Species lacking a habitat containing all three or, in the case of more mobile species, habitats sufficiently close to allow individuals to commute between areas supplying these requirements, are eventually doomed to local annihilation. An imbalance in forest fauna is a threat to the eventual standard of the forest.

The arguments raised for or against the projected timber industry cannot, at present, be supported by indisputable evidence or scientific knowledge. Therefore decisions are mainly hased upon logical deductions formed from the limited data presently available. Without further studies to provide the necessary information, no one can accurately assess the detrimental or advantageous effects.

Aims

In 1974, a programme was commenced to collect some of the fauna destined to be disrupted in the course of forest harvesting and to gather related data from associated fauna studies. The main objectives were to improve the Queen Victoria Museum's reference collections and to gather some basic information about forest fauna which might assist studies on wildlife and forest management. The following programme was to be followed:

1 Sampling zoological and botanical material.
2 Identifying species present and assessing their abundance at different times of the year.
3 Determining species distribution based upon habitat dependence.
4 Gathering data on food requirements, breeding, and support systems.
5 Observing and recording changes in faunal populations as forest harvesting and forest regeneration progressed.

This was to be undertaken as a part-time operation and as part of general field work. Therefore, the time available was limited to about one week each month.

Eighteen visits, totalling sixty-four days, have been made as follows: In 1974, 2-5 September, 14-18 October, 12-14 November; in 1975, 17-21 February, 24-27 March, 8-12 September, 13-17 October, 10-14 November, 8-12 December; in 1976, 12-14 January, 16-19 February, 15-19 March, 12-15 April, 10-14 May, 21-25 June, 2-6 August, 30 August - 3 September, 27 September - 1 October.

THE STUDY AREA

Physical Features

A number of potentially suitable areas in the north and east of the state were inspected during the winter of 1974 before a decision was made in September of that year to establish a field station on the northern slope of Maggs Mountain (see map and plate 1). The site was selected because it provided a good range of commercial forest habitats, was well serviced by roads and where forest harvesting was being undertaken. Additionally, a Forestry Commission building was available for accomodation and laboratory work. The area selected for study was approximately triangular and included the northern half of Maggs Mountain, from east to west between the Mersey River and the Arm River and north to south from the Borradaile turn-off to a line running west from Rowallan Dam.

The general topography is steep and mountainous, being cut by steep-sided valleys which tend to physically isolate sub-alpine plateaux. Maggs Mountain (lat. 41°41'S; long. 146°12'E. Map, and plate 14) is on the western side of the Mersey Valley and about 60 km south of Ulverstone. Its plateau is 880 m above mean sea level, the northern end, where the field station was established, slopes steeply down to the Arm River which, at that point, is 420 m above mean sea level. The field station is at an altitude of 450 m. Soil on the plateau is alluvial sand, gravel and talus which overlies basalt and related rock types. The Mersey River has been dammed at two points for generating electricity. Rowallan Dam is about 5 km up river or south of the field station and Parangana Dam is about 7 km down river or north of the field station. The dams have created two long narrow freshwater lakes to the south-east and north-east of the study area.

Climate

The winter climate is severe with temperatures falling as low as −12°C. Mean temperature for July is 2°C. Snowfalls are common and up to 30 cm of snow may cover Maggs Mountain plateau for several consecutive days before thawing commences. Elevated areas having a southern aspect or otherwise sheltered from the sun may carry snow patches for several weeks. Low cloud and mist often envelop the area.

In summer the temperature rises to 35°C with a mean for January of 10°C. Annual preciptation averages 160 cm, little of which falls in the summer months.

Under these conditions the ground cover dries out and periods of high fire danger usually occur between January and March.

VEGETATION

Timber cutting for saw logs has been undertaken in the area for many years and recently the more intensive forest harvesting practices have been introduced. These operations have contributed to a diversity of habitat types within the study area ranging from sub-alpine rainforest to wet sclerophyll and dry sclerophyll forest, grassland and areas at various stages of regeneration. Logging operations and reafforestation are continuing. The following brief descriptions and accompanying botanical lists broadly illustrate the habitat divisions under which data has been assembled and to which reference is made in the annotated fauna list.

Rainforest (plate 2)

In well matured stands, dominance is generally established by Myrtle *Nothofagus cunninghami* which forms a dense forest canopy about 50 m above ground and which shelters and shades the damp, moss-covered understory and forest floor where sunlight penetrates only through occasional breaks. In sub-climax rainforest, as is often the case in the study area, occasional overmature Stringybark *Eucalyptus obliqua* and Gum-topped Stringybark *E. delegatensis* may surmount the Myrtle canopy and stands of Silver Wattle *Acacia dealbata* may persist. Sassafras *Atherosperma moschatum* occurs regularly and, along the drainage system, Tree-fern *Dicksonia antarctica* grows prolifically, often attaining a height exceeding 3 m.

The forest floor is covered by a deep accumulation of leaves, twigs, branches and logs which remains for extensive periods due to the general absence of fire and the slow rate of decay. These accumulations, together with the trunks and lower limbs and branches of trees, are usually well covered with mosses and lichens and form natural cavities and shelter for small animals.

Wet sclerophyll forest (plate 3)

Dominant forest canopy species include Gum-top Stringybark *E. delegatensis*, Stringybark *E. obliqua*, White Gum *E. dalrympleana* and Silver Wattle *A. dealbata*, the upper canopy reaching to 70 m above ground. The understory, shrub layer and ground cover form a mixed vegetation, often comprising many species favoured as a result of logging at some former period and currently forming an early succession stage which would climax as rainforest were it given suitable protection and time to mature. Consequently, juveniles of rainforest species such as Dogwood *Pomaderris apetala*, Warratah *Telopea truncata*, Mountain Berry *Cyathodes parvifolia*, Fire Weed *Senecio linearifolius* and Mountain Pepper *Drimys lanceolata* usually are present.

A botanical collection, assembled from an area of wet sclerophyll-rainforest at the turn-off to the Borradaile Plains in September 1974 and now housed in the Queen Victoria Museum Herbarium, is listed in table 1.

Dry sclerophyll forest (plate 4)

White Gum *E. dalrympleana*, Peppermint *E. radiata* and Gum-top Stringybark *E. delegatensis* form the forest canopy, growing to a height of up to 70 m. Blackwood *Acacia melanoxylon* and Silver Wattle *A. dealbata* are interspersed as an understory in some areas, the latter regenerating readily in clumps when clearings are made by logging or fire. The shrub layer is relatively sparse and the forest floor relatively clear, often as a result of burning of the accumulated natural forest litter. Ground cover regenerates quickly, rushes *Juncus* sp., grass *Poa* sp., and bracken *Pteridium esculentum* being the main components.

A botanical collection, assembled from dry sclerophyll forest near the field station in September, October and November 1974 and now housed in the Queen Victoria Museum Herbarium is listed in table 2.

Regeneration (plates 5 and 6)

The area under observation in this category is Compartments 3 and 4 on the plateau of Maggs Mountain, at an altitude of 880 m. It was last logged about 1961 and burnt in March 1962, reseeding being by natural fall from the seed trees left standing. Sparse stands of pole timber have developed in some areas, interspersed with a few old over-mature eucalypts. It now supports a dense regrowth of Stringybark *E. delegatensis* and White Gum *E. viminalis* standing to about 6 m high. Mountain Pepper *D. lanceolata*, Silver Wattle *A. dealbata* and Mountain Berry *C. parvifolia* are prevalent in the shrub layer. Grass *Poa* sp. is the principal ground cover, forming a dense mat over much of the surface.

Odd patches of juvenile Celery-topped Pine *Phyllocladus asplenifolius* and Beech *N. cunninghami*, and the general proximity of stands of Beech-dominant rainforest suggests that this area was once part of an extensive rainforest much of which, having been logged to varying degrees, is now in an early stage of succession.

A botanical collection from this area in September, October and November 1974, held in the Queen Victoria Museum Herbarium, is listed in table 3.

Clear-cut (plates 7 and 8)

This area is Compartment 2 on the plateau of Maggs Mountain, adjacent to the regeneration (Compartments 3 and 4) previously discussed, and to areas of wet sclerophyll forest and rainforest. It consists of a rectangular block about 1.6 by 0.65 km (104 ha) of gently sloping ground at an altitude of about 880 m. Previously an area of wet sclerophyll forest and rainforest, it was logged in 1973. The remaining trees were felled and the shrubs bulldozed down in 1974. The whole area was burnt on 17 February 1975 (plate 7) and sown in May 1975. Burning left a bed of ash over soil broken up by bulldozing operations but many big limbs and trunks failed to burn completely and so remain covering much of the area. Some patches of grass in clearings and odd green heads of Myrtle *N. cunninghami* did not burn. Botanical specimens were collected in this compartment in February 1976. They are listed and relative abundance given in table 4.

The western edge is bounded by a control area 0.4 by 0.65 km (26 ha) (plates 9 and 10). It was logged with the rest of Compartment 2 but then left and not clear-cut or burnt.

Additional observations have been made in a similar habitat in the northern sector of Compartment 57 (plate 11) where an area of about 20 ha was clear-cut, burnt and sown at the same time. It is a section of the floor of the Arm Valley and supports some tea-tree scrub and areas of swamp and rushes.

METHODS

The problem of assessing abundance has been considered and discussed with other field workers. It was decided that in the present study, which because of other commitments was limited to mainly collecting specimens and associated data, relative abundance would be assessed from general field observations aided by any data collecting methods which might improve the reliability of the result. To achieve this, regular visits were made on a monthly basis from September 1975 to September 1976 and on each occasion specimens were collected and notes made on the occurrence of fauna. This method may not be acceptable to some but it is supported by the field experience of the author which spans a period of over forty years. The general knowledge of fauna, gained from training and field experience not often available to others, has greatly assisted the evaluation of data collected by general observations, spotlighting, trapping, netting, tracking and the identification of faeces and calls. Some of these indicators of presence or activity are often inapplicable by those who use entirely statistical methods in population counting. At the same time, allowances have been made for bias caused by influences of food, breeding, weather, migration and habitat preferences. Relative abundance has been chosen in preference to number-per-hectare because, in the present circumstances, it was not possible to devote the time necessary to undertake a more detailed statistical assessment. It also allows for consideration

of the additional indicators, discrepancies and biases previously mentioned and gives a meaningful and useful result by being the average for the general area and not restricted to the limitations of data collecting in a study plot.

Mammals

Observations were carried out at night aided by spot-lighting with a narrow beam lamp. Regular patrols were made by vehicle along logging roads and by walking along tracks and across clear-cut areas. Some marsupials were collected by shooting on most excursions. An estimated 30 hours, covering 500 kilometres of road patrols and 15 hours covering 20 kilometres of walks were made in these spot-lighting operations.

Trapping has been undertaken to establish the presence of some species of small animals. Wire cage traps (45 x 20 x 20 cm), Sherman tin box traps (23 x 9 x 8 cm) and breakback household rat traps were used. These were set for 450, 120 and 1200 trap nights respectively. Bait was used on all occasions and consisted of bread spread with peanut butter and honey. Fresh apple was used in conjunction with the bread bait in the cage traps and box traps. Mist nets were left set overnight for bats on four occasions during the summer of 1975-1976. The relative prevalence and distribution of faeces, footprints, digging, scratching and runways, together with severity of grazing and browsing were all considered in arriving at conclusions.

All mammals collected were searched for ectoparasites which were preserved in alcohol. All small mammals were preserved in 70% alcohol or 4% formalin. Of the large marsupials, only the skulls were retained after the animals were examined. Muscle samples were cut from most mammals and formalin-fixed for pathological examination (see appendix).

A list of the mammals recorded and their relative abundance in five habitat types is given in table 5.

Birds

The relative abundance of species in the classified habitats was recorded on each visit and an index number was given to each to denote its status (see tables and). This was assessed by observations, aided by 7 x 50 binoculars, by listening to birds calling and by random mist netting. Consideration was given to circumstances which could produce local bias, such as seasonal flocking, feeding congregations and weather. The secretive nature of some species, relative to those which are more conspicuous, was also taken into account. As much time as possible was devoted to these observations and the various influences considered before arriving at an assessment.

Specimens were collected by shooting with a 16 gauge shot gun and a .22 cal. rifle using both solid and dust shot cartridges. Random mist netting was undertaken to obtain additional specimens and distributional data. Up to six nets (40' by four shelf, 1¼" mesh) were worked at irregular times, totalling about 1000 mist net hours.

All birds collected were searched for ectoparasites which were preserved in 70% alcohol. The gut contents of all birds were extracted and preserved in 70% alcohol. A muscle sample was cut from the breast of each specimen and formalin-fixed for pathological examination (see appendix). Most birds were preserved in 70% alcohol, the exceptions being made into study skins.

A list of the birds recorded and their relative abundance in six habitat types is given in table 6. Their status and seasonal occurrence is given in table 7.

Amphibians

Frogs, tadpoles and eggs were collected by hand, fixed in 4% formalin and preserved in 70% alcohol. Records were kept of frog calls.

A list of species recorded in five habitat types is given in table 8.

Reptiles

Snakes and lizards were collected by shooting or by hand at every opportunity. All the lizards and most of the snakes were fixed in 4% formalin before preservation in 70% alcohol. Some snakes, not preserved, were passed to the Department of Agriculture for pathological studies (see appendix).

A list of the species recorded in five habitat types is given in table 8.

Fish

Other than casual observations and some hand collecting in the shallow water of the Mersey River, no work has been undertaken on the fish.

Invertebrates

These were collected as opportunity permitted but special emphasis was placed upon fauna living in the foliage of Silver Wattle *Acacia dealbata* and *Eucalyptus* spp. A series of samples has been collected in each month from September 1975 to May 1976. To gather specimens, a 45 litre plastic trash bin was held beneath the lateral foliage. The lid was then used to depress and beat the foliage into the top of the container and dislodge the animals. A small wad of chloroform soaked cotton wool in the bottom of the receptacle retarded escape. Each sample was preserved in 70% alcohol.

Botany

Samples were collected from a number of areas and habitat types. All were mounted and incorporated in the Queen Victoria Museum Herbarium.

Nomenclature

The nomenclature followed for mammals is that used by Green (1973); for non-passerine birds, Condon (1975); for passerine birds, Schodde (1975); for amphibians, Littlejohn and Martin (1974); and for reptiles, Rawlinson (1974). The terms rare, uncommon, common and abundant provide four broad categories of abundance, each group being designed to differ from the next by about tenfold.

THE FAUNA

The present faunal list and associated discussion is designed to record habitat preference, relative abundance, seasonal occurrence, and some breeding and behavioural data. This will describe the pattern of the present faunal distribution against which future trends may be measured. The broader reasons for the occurrence of some species in the different habitat types may appear fairly obvious but, for most, considerable investigation is required before their support systems can be understood. Habitat preference is sometimes confusing because there are always transitory individuals investigating habitats which are not of their natural environment. In assessing status in a particular habitat, it was considered important to differentiate between casual visitors, transitory species and residents which live and reproduce there.

Mammals

Brush Wallaby *Macropus rufogriseus*

Abundant throughout the areas of sclerophyll forests but less so in the rainforest. It leaves its diurnal cover at dusk to feed in grassy clearings and the verges of roads and logging tracks where it is easily observed by spotlight. It is also attracted to the clear-cut areas which provide an enhanced food supply after grasses and shrubs commence to regenerate in the first summer following burning. These areas are then invaded from the surrounding forests. Regenerating *Eucalyptus* spp. are often damaged severely by mammals, possibly this species, which prune the young trees to biting through the twigs, leaving the leaves trampled on the ground. In the autumn it would be normal to see five to ten per hour by spotlighting along roads, tracks or across clear-cut areas. After the

opening of the hunting season about June, the number is reduced by shooters taking wallabies for their skins and meat.

Tasmanian Pademelon *Thylogale billardieri*

Abundant, occurring in areas of rainforest, wet sclerophyll forest and the dense vegetation of valleys. At dusk, it leaves this diurnal shelter to feed in forest clearings and grassy verges and is easily observed by spotlighting. It is attracted by the enhanced grazing in clear-cut areas which it invades to feed under cover of darkness, possibly contributing to damage of young *Eucalyptus* spp. by pruning in the same manner as mentioned for the preceding species. Its population appears about similar to that of the Brush Wallaby and it is seasonally hunted and shot for its skins and meat along with that species.

Southern Potoroo *Potorous apicalis*

Common but with a patchy distribution in the sclerophyll forests where it forms runways beneath the dense vegetation and builds nests of grass and litter in which it rests. It is occasionally seen by spotlight at night, in partial clearings or on roadsides but is shy and does not venture far from cover. Though common and easily trapped in restricted areas, it is generally less plentiful than the Brush Wallaby and Tasmanian Pademelon. It has no commercial value and is totally protected by law.

Brush Possum *Trichosurus vulpecula*

Abundant throughout the whole area, living in all habitat types. It retires by day to holes in trees, logs or other refuges. It becomes active at dusk, spending most of the night on or near to the ground but, if pursued, it will usually escape by climbing into trees. Its food consists mainly of grasses, herbs and shrubs but the foliage of *Eucalyptus* spp. is also eaten. It damages some young trees and sprouts by browsing on the juvenile leaves. Black and grey animals occur in the population in approximately equal proportions. In autumn it would be normal to see ten to fifteen each hour by spotlighting along roads and tracks and in the clear-cut areas. During the winter hunting season it is shot using spotlights. Considerable numbers are taken in the study area and throughout the district generally for their commercially valuable skins. This noticeably reduces the population density until replaced by natural reproduction in the following year.

Common Ringtail *Pseudocheirus peregrinus*

Uncommon throughout the area but occurring everywhere except in treeless clearings. It hides by day in a nest composed of twigs and leaves, situated well above ground in a tree hollow or amongst dense foliage. It is almost totally arboreal, rarely descending to the ground, and feeds by browsing on the young shoots of trees and shrubs. It is therefore rarely seen in the headlights of vehicles but can be found by spotlighting, from as low as a few feet to high in the branches of the tallest trees. Individuals and pairs have been found in tea-tree in the Arm River valley and in both wet and dry sclerophyll forest on the slopes of Maggs Mountain. It has not been subjected to a hunting season for about 35 years.

Sugar Glider *Petaurus breviceps*

Rare. Only one animal has been observed by the author. This was by spotlight, high in the upper foliage of a *Eucalyptus* sp. in wet sclerophyll forest on the north-western slope of Maggs Mountain. Hunters say they occasionally find Sugar Gliders in the area when spotlighting for Brush Possums. It is almost totally arboreal, retiring by day to a tree hollow where it forms a nest of leaves gathered from *Eucalyptus* spp.

Eastern Pigmy Possum *Cercartetus nanus*

Rare. It has not been observed by the author but hunters say they occasionally see individuals when spotlighting for Brush Possums. They are said to be found on limbs and branches well below the canopy.

Common Wombat *Vombatus ursinus*

Common throughout the sclerophyll forests and clear-cut areas where it retires by day to burrows and hollow logs. It is occasionally seen in vehicle headlights

and when spotlighting, grazing on the verges of roadways and in forest clearings. In clear-cut areas its presence is often disclosed by its scratchings and faeces.

Brown Bandicoot *Isoodon obesulus*

Common in the areas of sclerophyll forest where it can be easily trapped on the edges of small clearings or along tracks. By day it retires to a domed grass nest which it forms in a depression in the earth amongst dense vegetation. It is occasionally seen on the verges of roadways in the headlights of a vehicle and its diggings, made while searching for food, are often found in grassy clearings.

Tiger Cat *Dasyurus maculatus*

One was seen on the 18th February 1976, sunning itself on a log, in dry sclerophyll forest and regrowth in the vicinity of the field station. Faeces and the occasional remains of eaten rabbits consistent with the activity of this carnivorous marsupial, also are indicators of its presence in the area. No nocturnal sightings have been made but hunters and timber cutters say they see it occasionally.

Tasmanian Devil *Sarcophilus harrisii*

A half-grown male was caught in a cage trap set in an open situation near the field station on the 14th November 1974. No other individuals have been sighted and discarded mammal carcasses are not noticeably scavanged. Faeces consistent with those of this marsupial are occasionally seen but its presence in the area may well be due to transient individuals originating from agricultural areas lower down the Mersey Valley.

Dusky Antechinus *Anthechinus swainsonii*

This marsupial has previously been found to occur commonly in rainforest and adjacent wet sclerophyll forest (Green, 1972). One has been caught in rainforest while trapping at Maggs Mountain and it is probable that its distribution and population here are similar to those in other such areas.

Eastern Swamp-rat *Rattus lutreolus*

Abundant in the rainforest and wet sclerophyll forest but less so in the dry sclerophyll forest. It forms runways and burrows beneath dense vegetation and is primarily vegetarian, being readily caught in traps baited with bread or apple. Despite its general occurrence it is rarely observed in the wild and does not enter buildings as do the introduced species.

Water Rat *Hydromys chrysogaster*

One was found road killed in the Arm River valley in September, 1974, and the species probably occurs sparsely throughout the drainage system.

Long-tailed Rat *Pseudomys higginsi*

Common in the rainforest and to a lesser degree in adjacent ecotonal areas. It hides by day in burrows, natural cavities in the forest floor or holes in decayed stumps and logs. It is omnivorous and forages over the forest floor for suitable items of food. If disturbed it quickly retreats to cover. Trapping in rainforest at Maggs Mountain yielded catches indicating populations consistent with those described by Green (1968). The habitat in Compartment 2, prior to cutting, was suitable for this rat and no doubt supported a population similar to those in other areas. When trapping there in June 1976, 17 months after the controlled burn, four were caught in sixty snap traps left set in the same sites for three successive nights. The habitat in which these rats were living is inconsistent with previous findings. It is believed that they were part of the original population, which had survived the burn by hiding in burrows and then were unable, or unwilling, to move to other habitats.

House Mouse *Mus musculus*

One was seen on a road when spotlighting on the plateau of Maggs Mountain and several were trapped on the northern slope in November, 1975. Both sites were several kilometres from the field station in wet sclerophyll forest. In May, 1976 five were trapped in and beneath the field station building, and in

June, 17 were caught in 180 trap nights on the clear-cut in Compartment 2.

Rabbit *Oryctolagus cuniculus*

Abundant along roadways, in clearings in the sclerophyll forest and in the areas of grassland in the Arm River valley (plate 12). It hides by day beneath vegetation or in shallow burrows and emerges at night to feed on the grassy verges and closely grazed areas. Roadways provide corridors through the forest and it uses these to expand its range and to penetrate newly cleared areas. Consequently clear-cut areas are soon invaded and there it thrives in the temporary grassland habitat. Though sightings are not common, its numbers are indicated by frequent scratchings in the earth and accumulations of faecal pellets. Black individuals form about 20 per cent of the population.

Lesser Long-eared Bat *Nyctophilus geoffroyi*

Two adults were taken by mist netting at dusk in the vicinity of the field station on 29th March, 1975. Odd bats occasionally are sighted while spotlighting but identification of these has not been possible.

Little Bat *Eptesicus pumilus*

An adult male was caught in a mist net left set overnight on 17th February, 1976.

Tasmanian Pipistrelle *Pipistrellus tasmaniensis*

Two adult males were shot at dusk at the field station on 18th February, 1976.

Feral Cat *Felis catus*

Uncommon in the area. Two individuals have been seen in the headlights of a vehicle and a road-killed cat was found on the plateau of Maggs Mountain.

Echidna *Tachyglossus aculeatus*

Common and regularly seen during spring and summer, rarely seen in autumn and never in winter. It occurs in all habitat types but favours the sclerophyll forests. Its diggings for food are commonly found.

Platypus *Ornithorhynchus anatinus*

Though not seen or collected locally, it no doubt occurs in the nearby Mersey River and Arm River.

Birds

Black Cormorant *Phalacrocorax carbo*

Singles, pairs or small parties were occasionally seen in flight, high above the Arm River. The species is known to breed in colonies in remote inland areas.

White-faced Heron *Ardea novaehollandiae*

One was present in trees on the edge of the Arm River in the northern sector of Compartment 57 and in the vicinity of the field station in March 1976.

Black Duck *Anas superciliosa*

One was disturbed at night from water-filled ruts in the clear-cut (Compartment 2) on Maggs Mountain plateau in September, 1975, a pair was flushed from a small drain in the clear-cut section of the northern sector of Compartment 57 in January, 1976, and a pair was seen flying above the clear-cut section on the Borradaile Plains on 2nd September, 1976.

Brown Goshawk *Accipiter fasciatus*

A pair was seen in flight at tree top height on the north side of Maggs Mountain in November, 1975. A pair was found nesting near the field station in September, 1976.

Wedge-tailed Eagle *Aquila audax*

The valley of the Arm River appears to be the centre of a territory occupied

by a pair which have nested in a large *Eucalyptus* sp. in the bottom of the valley. One, or both, were often seen flying over the study area and in February, 1976 they were accompanied by a juvenile.

Peregrine Falcon *Falco peregrinus*

One was seen flying above Maggs Mountain in September, 1976.

Brown Falcon *Falco berigora*

At least one pair lives in the vicinity of the field station. Individuals have been seen fairly regularly, from the Mersey River to the Maggs Mountain plateau (Compartment 2). A party of three, seen on the edge of grassland in the valley of the Arm River (plate 12) in January, 1976 included a juvenile.

Spotless Crake *Porzana tabuensis*

The tea-tree swamp in the northern sector of Compartment 57 (plate 11) supports a small population. Crake-like footprints were plentiful and calling was heard in March, 1976. In April, one adult and one subadult were caught in snap traps set on runways in the grass.

Tasmanian Native-hen *Gallinula mortierii*

A pair of birds live on the grassy verges of a small swamp, now well exposed by the clear-cutting, on the northern sector of Compartment 57. One chick was seen in December, 1974 but it apparently failed to survive. Three halfgrown chicks were found with the adult pair in January, 1976 and all were surviving in May. A few live in the areas of grassland further up the Arm River Valley (plate 12) and good populations occur on pasture land lower down the Mersey River valley.

Masked Plover *Vanellus miles*

Two pairs were found living in the grassland area of the Arm River valley (plate 12) in August, 1976. Transitory birds are sometimes heard calling as they fly down the valley at night.

Brush Bronzewing *Phaps elegans*

This species has been seen on one occasion only, when one was flushed from the road side about a kilometre north of the field station in 1974. One was heard calling from the forest on the north side of the Arm River valley in January, 1976.

Yellow-tailed Black Cockatoo *Calyptorhynchus funereus*

Uncommon and nomadic. A group of about six birds was regularly seen in the wet sclerophyll forest and rainforest on the northern side of the Arm River valley opposite the field station, during the summer of 1974-75 but sightings were not so frequent the following year. Pairs and individuals have been seen in other scattered areas including the Maggs Mountain plateau. A pair was found to be nesting in the hollow trunk of a lofty *Eucalyptus* sp., at a height of about 30 metres, on the north side of Maggs Mountain, in December, 1975. Timber, both fallen and standing, which has been broken up by the powerful beaks of cockatoos in their search of wood-boring larvae, is common throughout the area and may be found in habitats ranging from the clear-cut to rainforest.

Sulphur-crested Cockatoo *Cacatua galerita*

A pair lived in the rainforest and wet sclerophyll forest in the Arm River valley, opposite the field station and in the same area as a party of Black Cockatoos, during the summer of 1974-75 and the summer of 1975-76. A single bird was seen once on the Maggs Mountain plateau. In March, 1976 three (apparently the original pair and a juvenile) were seen in Compartment 57 in the Arm River valley. Other localised populations are known in various parts of inland north-western Tasmania.

Green Rosella *Platycercus caledonicus*

Common and sedentary throughout the year, principally in the sclerophyll

forests where it lives and feeds amongst the foliage of *Eucalyptus* spp. Green and Swift (1965) found psyllids belonging to the genus *Schedotrioza* were taken in quantity by rosellas cracking the galls on the foliage of *Eucalyptus amygadalina* at Greens Beach, northern Tasmania. They also make reference to the observations of others who found rosellas to be insect eaters. A small flock was observed feeding on the ripening seed heads of Fireweed *Senecio linearifolius* in Compartment 2 in May, 1976. During the spring, breeding pairs are dispersed throughout the forest and are relatively secretive. Outside the breeding season, this rosella forms loose flocks of about five to 20 birds which move through the forest in a noisy and conspicuous manner.

Blue-winged Parrot *Neophema chrysostoma*

Uncommon and migratory. Up to twenty were found living in the clear-cut in Compartment 2, in February and March, 1976. It was not breeding in the area.

Fan-tailed Cuckoo *Cuculus pyrrhophanus*

A common migrant, arriving in the area between late September and early October and departing again in February. During the intervening months it lives in the sclerophyll forests and calls regularly.

Shining Bronze-cuckoo *Chrysococcyx lucidus*

A common migrant, arriving here in October, and departing again in January and February. During this time it is widespread, occurring everywhere except in rainforest. Its presence often is disclosed by its regular calling.

Tawny Frogmouth *Podargus strigoides*

One bird was caught in a mist net at the field station in October, 1975.

Kookaburra *Dacelo novaeguineae*

Uncommon and sedentary in the sclerophyll forests. In winter it is less vocal and not so easily noticed.

Welcome Swallow *Hirundo neoxena*

A common migrant, arriving here in September and departing in February and March. It favours cleared or partially cleared areas and the verges of dry sclerophyll forest, rarely entering the forest canopy. Occupied nests have been found in November and December in buildings at the field station and beneath bridges in the area.

Tree Martin *Cecropis nigricans*

A common migrant, arriving in the area in late September and early October and departing again in March and April when migrating flocks are seen. It breeds in the area and reaches a population peak in December and January when the young birds are flying. Evening congregations on gravel patches at the field station in January and February numbered about fifty birds and their gravel pecking behaviour was similar to that described by Mollison and Green (1962). By March these congregations had reduced to less than ten birds.

It favours dry sclerophyll forest and cleared areas, and flies beneath the canopy where it nests in small cavities in the limbs and trunks of *Eucalyptus* spp.

Richard's Pipit *Anthus novaeseelandiae*

A rare migrant which occurs in the clear-cut areas when grasses are established. It is absent in winter. A single bird was found living in the clear-cut of Compartment 2 on the plateau of Maggs Mountain in November, 1975, ten months after the burn. A pair was found breeding in the grass-covered clear-cut in Compartment 57 in the Arm River valley in December, 1975. These man-made clearings are of a very temporary nature, the birds utilising them only until the regenerating forest renders them unsuitable.

Black-faced Cuckoo-shrike *Coracina novaehollandiae*

A common migrant which arrives in the area in late September and departs in early February. It usually occurs as singles or breeding pairs and lives mostly

in the canopy and subcanopy of the sclerophyll forests.

Scaly Thrush *Zoothera dauma*

Uncommon and sedentary. Seen and heard on several occasions in wet sclerophyll forest and thick tea-tree. One was netted in May, 1976 in the area of open grassland surrounding the field station.

Pink Robin *Petroica rodinogaster*

Uncommon and localised. During the summer it is almost exclusively confined to rainforest and the associated ecotone where it breeds and feeds from near ground level to subcanopy. Outside the breeding season it is sometimes found in adjacent sclerophyll forest. It requires rainforest in which to breed and the reduction of this habitat as forest harvesting continues will progressively reduce its distribution and population.

Flame Robin *Petroica phoenicea*

An abundant migrant which arrives in the area in late August and September forming loose flocks and feeding at or near ground level, amongst trees and in clearings. Breeding takes place in November and December and birds are then dispersed in pairs throughout the dry sclerophyll forest. In 1976 much of local population had moved away by mid-January and only individual grey birds were then found. A secondary influx, possibly by exiting migrants, occurred in February, March and April but all had moved away by May.

Scarlet Robin *Petroica multicolor*

An uncommon visitor which arrives in late summer and departs in early spring to breed at lower altitudes. It occurs primarily in the dry sclerophyll forest and associated clearings.

Dusky Robin *Melanodryas vittata*

This endemic robin is common and sedentary, living in the dry sclerophyll forest and adjacent clearings. It is somewhat gregarious in the spring and autumn and is then most conspicuous. Here breeding is generally later than in the lowlands, the birds being dispersed in breeding pairs and most secretive about November and December.

Olive Whistler *Pachycephala olivacea*

Common, sedentary and widespread occurring primarily in the wet sclerophyll forest but also in other areas, where the understory is dense. Its shy nature and striking call results in it being recorded by sound more often than by sightings. During November and December it was found to call rarely, probably due to breeding secrecy but by January, when the young were independent, it again called vigorously. In autumn and winter it often moves into open forest.

Golden Whistler *Pachycephala pectoralis*

Common and sedentary in the sclerophyll forests but favours the drier areas and avoids rainforest. It is most vocal during the breeding season, from October to December, living mainly in the shrub layer and subcanopy.

Grey Shrike-thrush *Colluricincla harmonica*

A common, sedentary bird of the sclerophyll forests and adjacent clearings throughout the study area, occurring all year round. It feeds from ground level to the subcanopy taking items ranging from insects and spiders, gleaned from beneath loose bark, to the nestlings of small songbirds.

Satin Flycatcher *Myiagra cyanoleuca*

A common migrant which arrives about the end of October and departs in March. Its favoured habitat is the dry sclerophyll forest on the lower slopes of the mountain where it is active and noisy, feeding amongst the branches and in the canopy. It is a regular local breeder.

Grey Fantail *Rhipidura fuliginosa*

A common migrant. Though present in almost every month there is a noticeable

build up in September and October. During the summer, it is one of the more common species and is a regular local breeder, occurring principally in sclerophyll forests and feeding from grass level to above the highest forest canopy. After March the population declines as birds move away. A small migrating flock was seen passing through in May, 1976.

Spotted Quail-thrush *Cinclosoma punctatum*

Uncommon and sedentary in the dry sclerophyll forest.

Superb Blue Wren *Malurus cyaneus*

An abundant, sedentary species which, except for rainforest, occurs almost anywhere there is sufficient shrub to afford protection. It is one of the first birds to appear in the clear-cut areas following burning, pairs and family groups searching for food by day and returning to the shelter of adjacent forest at dusk. It generally lives and feeds close to the ground but occasionally ascends to the lower branches of trees. It finds areas of regenerating *Eucalyptus* spp. to be an acceptable habitat, occurring in and below small saplings. Following an abnormally heavy fall of snow (plate 13) at the end of June, 1976 the population was considerably reduced, apparently by mortality resulting from the cold and inaccessability of food.

Southern Emu-wren *Stipiturus malachurus*

Rare and very localised. A pair was found breeding in a swampy, drainage area (plate 11) in the Arm River valley (Compartment 57) in November, 1975. In December flying young were also present, living amongst rushes and in tea-tree growing on the edge of the swamp. Its secretive nature makes it difficult to observe but some birds were found in the area in almost every month.

White-browed Scrubwren *Sericornis frontalis*

Common and sedentary, occurring in all habitat types where shrub is sufficiently dense to provide cover. It generally feeds close to the ground but will occasionally ascend to the lower branches of well foliaged trees for brief periods.

It is one of the first species to enter clear-cut areas following burning, pairs and individuals venturing from adjacent forest to explore amongst the remaining debris within days of the fire.

Scrubtit *Sericornis magnus*

An endemic species which is uncommon and sedentary, occurring mostly in rainforest and only rarely entering the adjacent wet sclerophyll forest. It lives and feeds mostly in the understory and shrub layer but occasionally ascends to the subcanopy. Its dependence upon rainforest indicates that its distribution and population will decline as these areas are progressively clear-cut.

Fieldwren *Sericornis fuliginosus*

Rare and sedentary, occurring in the treeless areas of native grassland in the Arm River valley where a small, localised population lives. Odd pairs were found breeding in the clear-cut areas of Compartments 2 and 57 in the summer of 1975-76, one year after the burn, by which time the growth of grass and weeds had provided sufficient cover for an acceptable short-term habitat.

Brown Thornbill *Acanthiza pusilla*

An abundant, sedentary species, occurring in all habitats except rainforest. It is most numerous in the dry sclerophyll forest and may be found feeding from ground level to the canopy. Here its distribution overlaps that of the Tasmanian Thornbill and the two species have been found together, in both wet and dry sclerophyll forest and in an area of eucalypt regeneration on the plateau of Maggs Mountain. It is most conspicuous in the spring and autumn when it forms loose flocks which move through the forest in a seemingly endless search for food. These flocks often occur in the clear-cut areas the first year after burning.

Tasmanian Thornbill *Acanthiza ewingii*

An abundant and sedentary endemic species. It occurs principally in the rainforest, wet sclerophyll forest and, to a lesser degree, in the adjacent dry sclerophyll forest and areas of regeneration where its distribution overlaps that of the Brown Thornbill. Its feeding range extends from the shrub layer to the forest canopy. It takes insects, spiders and larvae from the branches, twigs and foliage.

Yellow Wattlebird *Anthochaera paradoxa*

An endemic species which is common for much of the year. It is most noticeable in spring and autumn when it forms loose flocks and calls regularly as it moves about the canopy in sclerophyll forests. With the onset of breeding in October, the flocks disperse and the birds become secretive and less vocal. A partial exodus occurred in May, birds apparently retreating to lower altitudes and not returning until August or September.

In September, 1975 it was one of the most conspicuous birds on the Maggs Mountain plateau, feeding near to the ground amongst the foliage of the densely growing *Eucalyptus* sp. saplings in Compartments 3 and 4.

Yellow-throated Honeyeater *Lichenostomus flavicollis*

An abundant, sedentary, endemic species occurring in pairs or individuals. It lives and feeds from ground level to the sub-canopy, primarily in the sclerophyll forests where it takes insects and spiders from the trunks and branches. It is one of the early colonisers of regenerating forest, occurring in the clear-cut as a transient within a year of the burn. It was found living and breeding in Compartments 3 and 4 where the habitat consists mostly of *Eucalyptus* spp. to 4 m in height.

Strong-billed Honeyeater *Melithreptus validirostris*

An abundant, sedentary, endemic species, living in the sclerophyll forests. It is most conspicuous in November and December when flying young are obvious and noisy. Outside the breeding season it is gregarious and parties move about the forest from the canopy to the ground, probing amongst bark for insects and spiders.

Black-headed Honeyeater *Melithreptus affinis*

An abundant, sedentary, endemic species, occurring in the dry sclerophyll forest. It avoids the wet sclerophyll forest and though very numerous about the field station (450 m) it has not been found above 600 m on Maggs Mountain. It feeds mostly in the canopy but will descend to the understory and shrubs. Both adults and flying young were feeding near to the ground in the foliage of Silver Wattle *A. dealbata* in the vicinity of the field station in January, 1976.

Outside the breeding season, which extends from September to the end of the year, it is gregarious and parties move about the canopy feeding and calling almost continuously.

Crescent Honeyeater *Phylidonyris pyrrhoptera*

A common, local breeding species from September to November but less numerous from December when a post-breeding exodus occurs. Though primarily a bird of the sclerophyll forest, living in the understory and shrubs, it is sometimes found in the foliage of the old over mature *Eucalyptus* spp. standing above the canopy of rainforest. It also occurs in Compartments 3 and 4, the early regeneration area on the plateau of Maggs Mountain, where the understory is mostly *Eucalyptus* spp. standing up to 4 m high.

Eastern Spinebill *Acanthorhynchus tenuirostris*

Common in the rainforest and sclerophyll forests in spring, summer and autumn but apparently absent in June and July. It lives mostly in the shrubs and understory but occasionally ascends to the canopy.

Spotted Pardalote *Pardalotus punctatus*

A common species, seen and heard in every month but in spring and summer it is greatly outnumbered by the Striated Pardalote. It favours the dry sclerophyll

forest, usually feeding in the canopy but sometimes descending to the shrubs for brief periods.

Striated Pardalote *Pardalotus striatus*

An abundant migrant, arriving in August and September and departing in April. It is highly vocal from September to January when breeding takes place.

It occurs in most habitat types and is primarily a canopy feeder but will descend to the shrubs for brief periods. It takes its food from amongst the foliage and small twigs, spiders, insects, and larvae being principal items of its diet.

Silvereye *Zosterops lateralis*

An abundant partial migrant arriving in September and departing in May. It lives primarily in the sclerophyll forests where, for much of the year, it is one of the most commonly encountered species. It is a local breeder, nesting in the shrub layer, but many non-breeding birds are present and form loose flocks which feed amongst the foliage of Silver Wattles *A. dealbata*. Small foliage-eating larvae which plagued this tree were found to form the principal proportion of its diet in early spring but from November its diet consisted mainly of adult insects.

European Goldfinch *Carduelis carduelis*

Generally common and nomadic. It is gregarious outside the breeding season when flocks of up to one hundred may occur. It is attracted to the clear-cut areas where it feeds on the seed heads of the introduced Scotch Thistle *Cirsium vulgare* but may be found in most habitats. Its population dropped noticeably following an abnormally heavy snowfall at the end of June, 1976 (plate 13).

Beautiful Firetail *Emblema bella*

Common and sedentary, occurring in the sclerophyll forests. It generally favours the less dense areas where the shrubs are sparse but has often been seen on the verges of roads in wet sclerophyll forest and rainforest. It descends to the ground to feed amongst the grass in small clearings. An abnormally heavy snow fall (plate 13) at the end of June, 1976 distressed the population, apparently by reducing the accessibility of food and its numbers were noticeably decreased in the following spring.

Common Starling *Sturnus vulgaris*

A rare visitor. About three pairs were living at the field station in November, 1975. Though appearing as if about to nest in nearby *Eucalyptus* spp. breeding did not occur and all had abandoned the area by December.

Strong populations exist in the agricultural areas about 20 km lower down the Mersey River valley.

Dusky Woodswallow *Artamus cyanopterus*

An uncommon migrant, arriving at the end of September and departing in March. It was found in a restricted area of semi-cleared dry sclerophyll forest near the field station where one or two pairs were breeding in November, 1975.

Black Currawong *Strepera fuliginosa*

This endemic Tasmanian currawong is abundant and widespread throughout the highlands. It favours sclerophyll forests but also occurs in the areas of early regeneration and on the verges of rainforest.

It disperses for breeding about November and is then usually secretive. In winter and early spring it congregates in loose flocks, which may number up to 200 birds. It is an opportunist feeder, taking a wide range of items and moves from one food source to the next as conditions dictate. Congregations often occur where logging and bulldozing operations are taking place, as the birds have learnt that food organisms are exposed as a result of the disturbance. In August it was found to be feeding principally upon earth worms, hunting and catching them in a manner similar to that of the introduced Common Blackbird *Turdus merula*. The fruit of the Mountain Berry *Cyathodes parvifolia*, also forms an important part of its diet and regurgitated remains are conspicuous, especially in the vicinity of watering places.

Forest Raven *Corvus tasmanicus*

Uncommon and sedentary, usually being seen as stealthy pairs or individuals in the sclerophyll forests.

Amphibians

Brown Tree Frog *Litoria ewingi*

Abundant with a widespread distribution. It was heard calling in most months with a peak in October and November. Metamorphs were found in December.

Smooth Froglet *Crinia laevis*

Not found on Maggs Mountain but an extensive population was found in rushes and spagnum moss on the Borradaile Plains where it was calling and laying eggs in February.

Brown Froglet *Crinia signifera*

Common but with a localised distribution. Specimens were collected in October and November on the plateau of Maggs Mountain.

Tasmanian Froglet *Crinia tasmaniensis*

Common with a widespread distribution, occurring in most pools and drains. It was found calling and egg laying on the plateau of Maggs Mountain in September, 1975. By December, the tadpoles were well developed but most perished when pools dried up. Odd individuals were heard calling in February. Specimens were collected from September to February.

Reptiles

Metallic Skink *Leiolopisma metallica*

The most common reptile, favouring open sunny situations in dry sclerophyll forest. It was active and collected in every month from September to March and was abundant in Compartment 2 where it far outnumbered the Small-scaled Skink.

Spotted Skink *Leiolopisma ocellata*

Rare. Only one was seen, and collected. It was found beneath stones in a dry drain at the power station below Lake Rowallan in March, 1975.

Small-scaled Skink *Leiolopisma pretiosa*

Commonly seen and collected from November to March, principally along logging tracks in the fourteen year old regeneration of Compartments 3 and 4 on the plateau of Maggs Mountain. In this habitat it was found to be abundant, outnumbering the Metallic Skink and usually occurring several feet above the ground, sunning itself while clinging to sides of dry logs and stumps. It often held to vertical or overhanging surfaces and would retreat to cracks in the timber when disturbed.

She-oak Skink *Tiliqua casuarinae*

Uncommon. One adult was collected near the field station in February, one small juvenile on the Maggs Mountain plateau in March and an adult by the roadside in wet sclerophyll forest in September.

Southern Bluetongue Lizard *Tiliqua nigrolutea*

Common, occurring in the sclerophyll forests and open sunny situations. It was seen and collected from November to March.

White-lipped Snake *Drysdalia coronoides*

Common. Specimens were collected on the plateau of Maggs Mountain and at the field station between November and February.

Tasmanian Tiger Snake *Notechis ater*

Common with a widespread distribution. Specimens were found in all habitat types between October and March.

Topographical map centered on the study area at Maggs Mountain. Numbers represent compartments mentioned in the text. S = the field station, T = Borraidale turn-off, R = Rowallan Dam. Co-ordinates as represented by 10,000 metre grid intervals of the Australian Map Grid.

------- roads ——— rivers ——— contour lines at 40 metre intervals

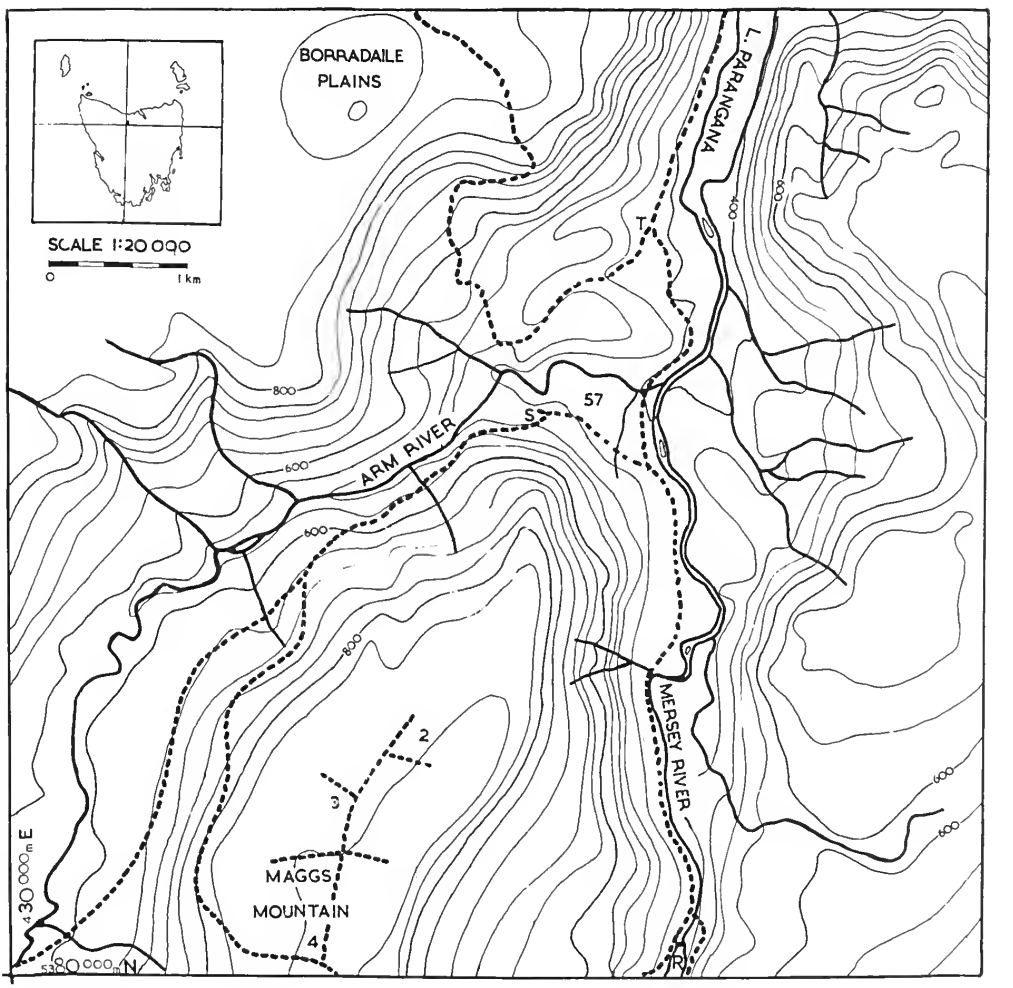

PLATE 1 North-eastern slope of Maggs Mountain from the road 100 m south of the Arm River bridge. Compartment 57 in the foreground with the valley swamp at bottom right.

PLATE 2 Myrtle *Notofagus cunninghami* rainforest with Tree-fern *Dicksonia antarctica* and accumulated wet forest litter, 200 m north-east of the Borradaile turn-off.

PLATE 3 Wet sclerophyll forest 200 m up-stream from the Arm River bridge on the north side of the river. The area was once logged and now supports dense regrowth.

PLATE 4 Dry sclerophyll forest on the northern slope of Maggs Mountain above the Arm River road and about 5 km west of the field station. The millable trees were cut out some years ago.

PLATE 5 Compartment 3 on the plateau of Maggs Mountain looking north from the access road in August, 1976. The area was logged for sawlogs about 1961 but not clear-cut. It was burnt in March, 1962 and reseeded by natural fall from seed trees left standing.

PLATE 6 The access road on the southern edge of Compartment 4 looking west on the plateau of Maggs Mountain in August, 1976. The area was logged about 1961 and burnt in March, 1962. Reseeding was by natural fall from seed trees left standing.

PLATE 7 Compartment 2 on the plateau of Maggs Mountain, the day after the controlled burn of 17 February, 1975.

PLATE 8 Compartment 2 in August, 1976 showing regrowth of grass and fireweed eighteen months after the controlled burn (see plate 7). Eucalypt seedlings are up to 20 cm high.

PLATE 9 The western section of Compartment 2 on the plateau of Maggs Mountain, a few weeks after being logged in the winter of 1974 and left without being bulldozed or burnt, as a control area for future comparison.

PLATE 10 The control area in Compartment 2 two years after it was clear-cut (see plate 9).

PLATE 11 The northern section of Compartment 57 in the Arm River valley. The swamp in the foreground is the habitat of the Emu-wren, Spotless Crake and Tasmanian Native Hen.

PLATE 12 Grassland in the Arm River valley 5 km west of the field station. The area, once mostly forest, was cleared by hand many years ago and is now used for cattle grazing during autumn.

PLATE 13 Heavy snow near the field station at Maggs Mountain in the fourth week in June, 1976.

PLATE 14 Looking west over Maggs Mountain (middle distance) which appears as a ridge separating the Arm River (beyond) and the Mersey River. The Arm River joins the Mersey River below the northern end of Maggs Mountain. The small clearing in the foreground is Dublin Plain.

Fish

Very few observations were made. Blackfish *Gadopsis marmoratus* and Short-finned Eel *Anguilla australis*, occur in the Mersey River. Brown Trout *Salmo trutta* have been introduced and are now abundant.

THE EFFECTS OF PULP-WOOD OPERATIONS

Clear-cut, slash and burn

This method of logging is used where both saw and chip logs are extracted from a defined area (or compartment) in a single operation. Most of the timber cut in Tasmania is now taken by this method in forests which have been previously selectively logged for sawlogs. Compartment size may vary from a few to several hundred hectares and is dependant upon physical features and environmental considerations. Following tree-felling and the removal of all the commercially acceptable logs from a compartment, the area is slashed in preparation for burning. For this, bulldozers are used to break down the shrubs and smaller trees and many of the remaining large cull trees, unacceptable to the industry and which may dominate and impede subsequent regeneration, are felled by chainsaw. Those which are not unduly detrimental to regeneration are left standing and provide some shelter and nesting sites for mammals and birds. The residue is then left for some months to die and dry out in preparation for firing. When compartments are not bordered by roads, fire breaks are cleared by bulldozing. At lower altitudes burning is generally carried out under mild conditions and days of high fire danger are avoided. At high altitudes it is necessary to burn in mid-summer because conditions are seldom satisfactory at other times. Burning seldom removes the material above 20 cm in diameter but it may improve access within the compartments and reduce the risk of future wild fires. It also provides a better seed bed for subsequent sowing or planting. Ignition is achieved by a crew of men moving across the compartment, lighting the dead vegetation at regular intervals. The perimeter is patrolled as a check against the possibility of fire jumping a break and igniting adjoining areas. An area of one hundred hectares may be fired in an hour but large timber may continue to burn or smoulder for some days.

Seeding, from an aeroplane or by hand, is undertaken in the following winter, with eucalypts of the same species and in the same ratio as previously grew in the area. Germination occurs in spring and seedlings may grow to 20 cm by the end of the first summer.

The immediate effects on the fauna

During the spring and summer of 1974-75, the general effects of clear-cut, slash and burn on the fauna of an area were noted. Compartment 2 on the plateau of Maggs Mountain was selected as being typical and convenient for continuing study. Observations made here and in Compartment 57 over this period form the basis for the following comments.

The felling of trees and removal of saw and chip logs has the immediate effect of completely disrupting all fauna in the area. The noise of machinery and falling of trees frightens most mammals and birds. Wallabies, possums and most birds then evacuate to adjoining forest. Alternatively, Black Currawongs are attracted to food exposed by logging operations and may congregate there while the disturbance continues.

Following the completion of logging operations, and in the absence of slashing, bulldozing or any further disturbance, Brush Wallabies and Tasmanian Pademelons start to move back, hiding beneath the surviving shrubs and accumulated litter. Arboreal marsupials and canopy feeding birds are limited by the amount of tall timber left standing and this is rarely sufficient to support breeding populations. A few Superb Blue Wrens, White-browed Scrubwrens and Brown Thornbills re-establish and breed in the first year.

Without further disturbances such an area may, within a few years, regenerate sufficiently to provide habitat favourable to many sclerophyll forest species. The

semi-open conditions allow sunlight to penetrate and shrub dwelling birds to flourish. The dense regeneration also provides good habitat for some ground dwelling mammals. As saplings grow, their foliage provides an increasing habitat range for canopy dwelling birds and arboreal marsupials. Such canopy gain will, in time, prove detrimental to some shrub dwelling species, especially birds, as those not adapted to living below a closed canopy then find survival difficult.

When clear-cutting is undertaken, most of the remaining cull trees are felled and the shrubs and understory are bulldozed down in order to kill off and dry out the vegetation, thus producing higher inflammability and a more complete burn. This secondary disruption further reduces shelter when foliage dries and falls. The area may remain a suitable habitat for Brush Wallabies, but it is abandoned by most other mammals and birds. Except for the wallabies, a few White-browed Scrubwrens, thornbill species and occasional transient mammals and birds it appears derelict and deserted.

Observations during burning showed Brush Wallabies to be a common escapee and they move out of the compartment well ahead of the fire. Some White-browed Scrubwrens were also seen to be dispersed by smoke, crossing to adjoining areas well ahead of the flames. Very little other fauna activity was noticeable.

A search undertaken the day after burning failed to reveal any carcasses. Some wallaby tracks were found in the ash, providing evidence of exploratory animals returning in the first night after burning when the whole area was still well lit by burning logs and trees. Black Currawongs and Forest Ravens were over the area, possibly attracted by lizards, insects and spiders moving about the unburned patches. The lizards and invertebrates apparently had survived underground or inside wet, unburned logs.

Five weeks later an inspection showed the area to be almost totally deserted except for odd transitory flying insects, some spiders and some Metallic Skinks. Light peripheral grazing indicated some nocturnal activity by mammals from adjoining forest.

Emigrants from an area so affected may survive for a while by being absorbed in the adjacent populations but the creation of any excess above natural levels inevitably creates interspecific competition for food, shelter and breeding sites. Ultimately, populations are reduced to levels compatible with the capacity of the habitat.

Postburn: the first eighteen months

Regular monthly visits, each of about three hours duration, were made to Compartment 2. These revealed little change in the vegetation until after the following winter. Some grazing was evident and fresh faeces and footprints of Brush Wallabies, Common Wombats, Brush Possums and Rabbits were found.

In September, the old established grasses began to produce spring growth and by December there were many vigorous stands running to seed. Ferns *Polystichum proliferum* were regenerating and Fireweed *Senecio velleioides* and *S. linearifolius* were growing prolifically. Fresh faeces of grazing marsupials and rabbits were very plentiful and an Echidna was found searching for food. Tadpoles of the Brown Tree-frog and of a froglet *Crinia* sp. were numerous in water-filled ruts and depressions.

In January *Eucalyptus delegatensis* seedlings were up to about 10 cm high, lacking any evidence of browsing. A few young wattles, *Acacia* sp., were also present. Insects such as flies, butterflies, moths, grasshoppers and field crickets were plentiful. Metallic Skinks were generally distributed throughout the area.

In February the grass on undisturbed areas was up to 30 cm tall and in seed. Marsupial and rabbit faeces and the associated footprints and scratching in the earth were very common. Considerable grazing pressure was evident on grass and shrubs. Fireweed and Scotch Thistles were plentiful and commencing to flower. Ten species of insect- and seed-eating birds were present as follows: 2 Green Rosellas, 1 Fantail Cuckoo, 1 Shining Bronze-cuckoo, 18 Flame Robins,

4 Dusky Robins, 2 Grey Shrike-thrushes, 2 White-browed Scrubwrens, 4 Superb Blue Wrens, 15 Striated Pardalotes, 5 Yellow-throated Honeyeaters, 15 Blue-winged Parrots and 3 Fieldwrens.

A series of plants were collected in February, 1976 from within Compartment 2 and are now housed in the Queen Victoria Museum Herbarium. Table 4 gives a list of these together with an indication of their abundance.

In March, the general appearance of the area and the fauna it supported appeared similar to that of February.

In April, the young eucalpyts had reached to about 20 cm in height and mammal browsing and leaf pruning of these was general over much of the area. The fine foliage was being severed from the stems and dropped on the ground close round the plant. Little appeared to have been actually eaten and affected plants had a soiled and rather trampled appearance. The animals responsible for this were not determined. Wallaby species, Brush Possum, Common Wombat and Rabbit faeces were abundant. Fireweed was being pruned in a similar manner and grass was well grazed in patches. Seven species of birds were found comprising 14 Flame Robins, 2 Dusky Robins, 1 Grey Shrike-thrush, 2 White-browed Scrubwrens, 8 Superb Blue Wrens, 1 Fieldwren and about 100 Goldfinches which were feeding on the seed heads of Scotch Thistles.

In May, mammal damage to young eucalypts and Fireweed was continuing and grass was well grazed in patches. The faeces of marsupials and Rabbits were plentiful. Goldfinches were still present and feeding on Scotch Thistle seeds. A flock of about 15 Green Rosellas was found in the compartment and were feeding on the ripening seed heads of Fireweed *S. linearifolius*. Two Grey Shrike-thrushes, 8 Brown Thornbills, 4 White-browed Scrubwrens, 20 Superb Blue Wrens, 3 Yellow-throated Honeyeaters, 1 Beautiful Firetail and 2 Fieldwrens were also found. About 5 cm of snow had fallen in early May and lay for about two days but very little autumn rain had fallen and the area was unusually dry. A few small, undetermined tadpoles were found in odd water-filled ruts.

In June, conditions appeared similar to those of May. Twenty Green Rosellas, a pair of Scarlet Robins, 2 Dusky Robins, 2 Firetails, 4 Forest Ravens, 2 Black Currawongs, 1 Fieldwren and a flock of about 20 Goldfinches were found in the compartment.

In July, a fall of snow (see plate 13) prevented a visit to Compartment 2. Up to 15 cm covered exposed areas round the field station for a week, and the fall on the plateau would have been considerably heavier.

COMMENTS

The complete lack of evidence in the area of such mammals as the Forester Kangaroo *Macropus giganteus*, Eastern Bettong *Bettongia gaimardii*, Little Pigmy Possum *Cercaretus lepidus*, Barred Bandicoot *Perameles gunnii*, Quoll *Dasyurus viverrinus*, Swamp Antechinus *Antechinus minimus* and Broad-toothed Rat *Mastacomys fuscus* is not surprising as the wet highland forest environment is not favourable (see Green, 1973). Table 5 lists the species occurring at Maggs Mountain and gives four degrees of abundance in five different habitats.

The apparent absence of some species of birds is not so easily explained. It does seem probable that some, such as quail and snipe might eventually appear in clear-cut areas as these extend. It is also most likely that future observations will record additional species such as Little Black Cormorant *Phalacrocorax sulcirostris*, Little Pied Cormorant *P. melanoleucus*, Chestnut Teal *Anas castanea*, Musk-duck *Biziura lobata*, Swamp-Harrier *Circus aeruginosus*, Grey Goshawk *Accipiter novaehollandiae*, Collared Sparrowhawk *A. cirrocephalus*, Spotted Owl *Ninox novaeseelandia*, Masked Owl *Tyto novaehollandiae*, Swift Parrot *Lathamus discolor*, and Spine-tailed Swift *Hirundapus caudactus*. However, such occurrences probably will be rare and mainly of a nomadic or transitory nature.

The absence of records of Pallid Cuckoo *Cuculis pallidus*, Yellow-winged Honeyeater *Phylidonyris novaehollandiae*, and Little Wattlebird *Anthochaera*

chrysoptera during the two years of observations is surprising as all occur commonly in a fairly wide range of lowland habitats. Most of the remaining Tasmanian bird species not recorded in the area are those which may be expected to avoid the wet highland forests.

The dry sclerophyll forest supports a greater number of bird species than other habitat types. Table 6 shows that of the 56 bird species recorded in the study area to date, 45 (80%) occur in the dry sclerophyll forest. Thirty-three (59%) occur in the wet sclerophyll forest and 16 (29%) occur in rainforest.

The 26 species (46%) recorded from clear-cut areas within eighteen months of burning is surprisingly high in comparison to other habitats. This is partly explained by the inclusion of a number of transitory or exploratory species which are merely passing through but it also reflects the arrival of some grassland species which cannot live in the forests.

Only three of the ten species of Tasmanian amphibia have been found at Maggs Mountain though a fourth has been found in considerable numbers on the nearby Borradaile Plains. Two of the three land snakes occur commonly and five of the 12 species of lizards have been found. Table 8 gives the relative abundance of these in five different habitats.

IMPRESSIONS

This study has been too brief to draw conclusions about the effects of clear-cutting upon the fauna or to make recommendations for future fauna management in such areas. It is natural, however, that two years spent at Maggs Mountain have left me with some impressions of the effects of present forestry activity upon some of the wildlife and of clear-cut operations in particular. In the present absence of data upon which sound management plans can be based, it is fair and, hopefully, useful to present some comments.

Vertebrate animals decrease numerically, both in species and individuals, with increasing altitude. This is evident on the northern slope of Maggs Mountain and it does not appear to be directly attributable to the vegetation. No species is exclusively altitudinal, all those occurring on the plateau being represented in greater abundance at lower altitudes. The high altitude forests (about 700 m) may therefore be seen as providing an extension of distribution for the altitudinally tolerant species, especially with respect to the avifauna, and are not critical to the survival of any vertebrate species. Alternatively, the presence of vertebrate animals in high altitude forests may, by their predation upon the invertebrate fauna and other activities, be important in the development of good quality trees.

The forests of lower altitudes (below 700 m) provide the principal habitats for many vertebrate species and the methods of management in these areas must have an important bearing on the eventual populations of many species. Likewise, the maintenance of a healthy, well-balanced fauna must be commensurate to good forest management and satisfactory forest regeneration.

The problems of fauna conservation, in relation to reafforestation, should not be considered for simply deriving systems to save animals for their own sake. Vertebrates form the upper links in the natural food chain and are of vital importance to the maintenance of a balanced ecology and a healthy, vigorous and productive forest. Both are of equal importance to foresters and zoologists and the work of each must be closely related.

The past era of selective felling for quality sawlogs has degraded forests and is detrimental to maximum commercial timber yields but its effect upon the fauna has not been drastic. Alternatively, the present method of clear-cut, slash and burn, though advantageous to vigorous eucalypt regeneration at lower altitudes, is devastating in its immediate effect upon forest fauna. A few grassland birds invade and utilise such a habitat for short periods, some even to breed, and some forest species occur as transients until the vegetation increases sufficiently to provide suitable residence. Some grazing marsupials

are favoured by a short term improvement in food and invade from surrounding forests to feed during the night. Such occurrences are the exception for by far the greatest proportion of forest fauna species cannot successfully re-establish themselves for years. For many species, we do not yet know the stage of regeneration a clear-cut forest must attain before it becomes an acceptable and viable habitat. Nor do we know the effects of such specific absenteeism upon successful forest regeneration, particularly when the areas of forest under regeneration are expanded significantly.

It therefore seems reasonable to assume that forest harvesting should be conducted on a cutting level somewhere between the earlier selective sawlogging operations and the complete clear-cut, slash and burn method.

Old, overmature or dead trees, especially those with decaying trunks or containing cavities are essential if those species of birds which rest and breed in such places are to be retained. Likewise, they are used by arboreal marsupials and bats. Such trees are therefore vital in a maturing forest and provision should be made to retain as many as practically possible. Allowance should also be made for replacements by retaining some submature trees of various ages, scattered throughout the area as shelter-wood for fauna as well as for the regenerating shrub layer. The retention of as many tall, foliaged trees as possible in a compartment also encourages the retention of foliage dwelling fauna and if sufficient, could provide for a viable, though greatly reduced, population.

Just as the removal of trees removes the canopy fauna, so the slashing and burning of the shrub layer removes the shrub-dwelling fauna. In areas where slash and burn has not taken place following clear-cutting, it is evident that some shrub-dwelling species remain and in some instances, successfully breed. Thus, if slash and burn can be avoided and an acceptable level of forest regeneration still achieved, it appears to be an advantageous step towards fauna retention.

The compartment size for providing the earliest and best recolonisation, whatever it may be, obviously varies according to physical conditions and the species concerned. Some animals are highly intolerant to change while others adapt and their populations increase.

Under favourable conditions most species provide an excess of offspring for replacement stock and these can only survive when sufficient space of a suitable quality is available. As an area regenerates it should provide this requirement, gradually and at differing times for different species. Recolonisation is a gradual process, developing in parallel with the growth of vegetation. This gradual development reaches out from the forested periphery progressively enveloping and colonising as the quality of the habitat required by the respective species reaches acceptability. The ability of species to undertake this process suggests that compartment size is relatively unimportant when a source of supply stock is available.

The return and re-establishment of vertebrates to regenerating forest is dependent upon food, shelter and conditions for breeding. As a food source is re-established, relevant species will move in to take advantage whether grazers, browsers, insectivores or carnivores. The beginning of the food chain must be established before the higher links can be expected to appear.

The size of compartments should be considered firstly in relation to factors which may affect the re-establishment of plants and invertebrate fauna. As re-establishment is not a quick, short-term operation but rather a gradual spread and development over many years as respective stages of growth are reached, there is little advantage in keeping compartments very small (e.g.) less than 500 ha. The distance from established forest already supporting a fauna source, the amount of shelter wood and aged trees left standing and, of prime importance, time for recolonisation before the adjoining forest is cut are factors with a far greater bearing upon successful re-establishment. Provided these three factors are considered, together with conditions dictated by the topography, the reafforestation and associated fauna establishment can be equally successful in a large compartment, say 10 000 ha, as in one of 100 ha. The animals will propogate

and spread at a rate equal to that of the development of their requirements.

In this sense, it is equally true to suggest that a strip compartment, say 2 km wide and of indefinite length, can be just as successfully redeveloped as one with a radius of 1 km.

Large compartments may be desirable as they provide greater scope for the highly sedentary species, enabling them to maintain viable populations without the need for inter-compartment movement. Large compartments may also be less susceptible to browse damage in the first few years of regeneration because the areas from which the herbivors invade at night are further from the compartment centre.

ADDENDUM

Examination of Animals for Parasites and Disease Processes

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During 1975 and early 1976 tissues from a wide range of birds, a limited number of mammals and one species of snake were examined. In some instances, whole carcasses were available but most studies were undertaken on samples of formalin-fixed muscle and gastro-intestinal tract.

Findings will be discussed under the headings of sporozoan parasites, helminth parasites and miscellaneous conditions.

Sporozoan parasites

Sporozoa are parasitic protozoans which include such potentially pathogenic organisms as *Toxoplasma gondii*, *Sarcocystis* spp. and the various intestinal coccidia. No appropriate methods were used for the detection of *Toxoplasma*, but some tissues were examined for *Sarcocystis* and intestinal coccidia.

(a) *Sarcocystis* in native rats

Microscopic sarcocysts with thick walls were detected in the skeletal muscles, but not heart muscle of the Velvet-furred Rat *Rattus lutreolus* and the Long-tailed Rat *Pseudomys higginsi*. The technique used was to examine about 20 sections of muscle from each animal and the prevalence rates obtained by this method was approximately 50%.

As *Sarcocystis* spp. have a cycle between prey and predator with the sarcocysts in the prey, a number of potential predators were fed *Sarcocystis*-infected *R. lutreolus*. No evidence of successful transmission was obtained when these animals were fed to Quolls *Dasyurus viverrinus*, domestic cats *Felis catus* or a Masked Owl *Tyto novaehollandiae*. After these feeding trials were completed one of two Tiger Snakes *Notechis ater* from Maggs Mountain was found to have an intestinal infection with a sporozoan with typical *Sarcocystis* morphology. Sporocysts (7 x 10 µm with 4 sporozoites) from this animal were dosed into two laboratory rats *R. norvegicus* one of which died 17 days later and the other was killed 4 months later. The animal which died had myocarditis with the presence of *Sarcocystis*-type schizonts and the other rat had sarcocysts in its muscle. One of two rats kept as controls in the same cage also had tissue sarcocysts, but it is believed that this infection was derived from sporocysts which passed through the gastro-intestinal tracts of the dosed animals. These findings are similar to those of Rzepczyk (1974) and Zaman and Colley (1975) who have demonstrated a python/rat cycle for *Sarcocystis* in northern Australia and Singapore.

The pathogenicity of this species of *Sarcocystis* is of interest as it may be responsible for some mortality in colonies of native rats.

(b) *Sarcocystis* in native birds

Sarcocysts were detected in Strong-billed Honeyeaters *Melithreptus validirostris*, a Grey Shrike-thrush *Colluricincla harmonica*, a Beautiful Firetail *Emblema bella*, a White-browed Scrubwren *Sericornis frontalis*, a Tree Martin *Cecropis nigricans*, Black Currawongs *Strepera fuliginosa* and a Scarlet Robin *Petroica multicolor*.

It is presumed at this stage that these are all the same species of *Sarcocystis*, and are the result of the birds ingesting infective sporocysts with food or water. To date no potential predators of these birds, which have been collected at Maggs Mountain, have been found to have *Sarcocystis*-type intestinal infections.

(c) Intestinal coccidiosis

Intestinal coccidia, believed not to be part of a *Sarcocystis* cycle, were seen in sections of intestine from a number of birds and one snake. The infections did not appear to be of significant pathogenicity.

The species were:

1. Birds

White-browed Scrubwren *Sericornis frontalis*
Yellow-throated Honeyeater *Lichenostomus flavicollis*
Grey Shrike-thrush *Colluricincla harmonica*
Black-headed Honeyeater *Melithreptus affinis*
Flame Robin *Petroica phoenicea*
Silvereye *Zosterops lateralis*
Superb Blue Wren *Malurus cyaneus*

2. Reptiles

Tiger Snake *Notechis ater*

Helminth parasites

(a) Trematodes

1. Parasites with the morphology of trematodes were detected in the pancreatic ducts of a *N. ater*.

2. An *Athesmia* sp. was present in the bile ducts of several *R. lutreolus*.

(b) Cestodes

A *Himenolepis* sp. was recovered from the intestines of *R. lutreolus* and strobilocerci of *Taenia taeniaeformis* were present in the livers of some of these animals.

(c) Nematodes

1. Tiger Snake *N. ater*
Ophidascaris pyrrhus from stomach

2. Lesser Long-eared Bat *Nyctophilus geoffroyi*
Filarioids from heart

3. Velvet-furred Rat *R. lutreolus*
Protospirura muris from stomach
Heligosomes from small intestines
Gangueterakis spumosa from large intestine

Miscellaneous conditions

(a) Focal hepatitis was a common finding, characterised by the presence of foci of mononuclear cells scattered throughout the liver parenchyma. Species affected

were Superb Blue Wren *M. cyaneus*, White-browed Scrubwren *S. frontalis*, Yellow-throated Honeyeater *L. flavicollis*, Black Headed Honeyeater *M. affinis*, Striated Pardalote *Pardalotus striatus*, Grey Shrike-thrush *C. harmonica*, Golden Whistler *Pachycephala pectoralis*, Satin Flycatcher *Myiagra cyanoleuca*, Dusky Robin *Melanodryas vittata*, Velvet-furred Rat *R. lutreolus*, Long-tailed Rat *P. higginsi*. There was no obvious cause of these lesions.

(b) Focal interstitial nephritis was found in one *R. lutreolus*.

(c) A high proportion of *R. lutreolus* has inflammatory lesions of the lungs, especially peribronchial cuffing by mononuclear cells.

TABLE 1 Botanical species collected in an area of wet sclerophyll-rainforest at the Borradaile turn-off near Maggs Mountain in September 1974.

GYMNOSPERMAE	PODOCARPACEAE	*Phyllocladus asplenifolius*
ANGIOSPERMAE		
DICOTYLEDONS	RANUNCULACEAE	*Clematis aristata*
	VIOLACEAE	*Viola hederacea*
	PITTOSPORACEAE	*Pittosporum bicolor*
	ELEOCARPACEAE	*Aristotelia peduncularis* (Heart Berry)
	RUTACEAE	*Zieria arborescens* (Stinkwood)
	RHAMNACEAE	*Pomaderris apetala* (Dogwood)
	LEGUMINOSAE	*Acacia dealbata* (Silver Wattle)
		Oxylobium ellipticum (Golden Rosemary)
	ROSACEAE	*Rubus gunnianus*
	MYRTACEAE	*Eucalyptus obliqua* (Stringybark)
		Eucalyptus delegatensis (Gum-top Stringybark)
	RUBIACEAE	*Coprosma nitida*
	COMPOSITAE	*Olearia viscosa*
		Senecio linearifolius
		Senecio sp.
		Helichrysum rosmarinifolius
	EPACRIDACEAE	*Leucopogon ericoides*
		Monotoca glauca
		Cyathodes juniperina
		Cyathodes parvifolia
	OLEACEAE	*Notelaea ligustrina* (Native Olive)
	MONIMIACEAE	*Atherosperma moschatum* (Sassafras)
	PROTEACEAE	*Lomatia tinctoria* (Guitar Plant)
	THYMELIACEAE	*Pimelea drupaceae*
	FAGACEAE	*Nothofagus cunninghamii* (Myrtle)
MONOCOTYLEDONS	ORCHIDACEAE	*Chiloglottis gunnii*
		Corybas dilatatus
	LILIACEAE	*Drymophila cyanocarpa* (Blue Berry)
	GRAMINEAE	*Poa* sp.
PTERIDOPHYTA	ASPIDIACEAE	*Polystichum* sp.
	BLECHNACEAE	*Blechnum* sp.
	DICKSONIACEAE	*Dicksonia antarctica* (Tree Fern)
	GRAMMITIDACEAE	*Grammitis* sp.
BRYOPHYTA	MUSCI	7 spp. unidentified
	HEPATICAE	2 spp. unidentified
MYCOPHYTA		4 spp. unidentified

TABLE 2 Botanical species collected in an area of dry sclerophyll forest at Maggs Mountain in September, October and November, 1974.

ANGIOSPERMAE		
DICOTYLEDONS	RANUNCULACEAE	*Ranunculus pascuinus*
		Ranunculus spp. (2)
	VIOLACEAE	*Viola* sp.
	ELAEOCARPACEAE	*Aristotelia peduncularis*
	GERANIACEAE	*Geranium* sp.
	STACKHOUSIACEAE	*Stackhousia* sp.
	LEGUMINOSAE	*Acacia melanoxylon* (Blackwood)
		Acacia dealbata
		Pultenea juniperina
	BOSSIAEA	*Bossa cordigera*
		Daviesia latifolia
		Goodia pubescens
	ROSACEAE	*Acaena* sp.
		Rubus sp.
	DROSERACEAE	*Drosera auriculata*
	MYRTACEAE	*Eucalyptus viminalis*
		Eucalyptus delegatensis
	RUBIACEAE	*Coprosma nitida*
		Coprosma hirtella
	COMPOSITAE	*Olearia lirata*
		Helichrysum dendroideum
		Helichrysum sp.
		Senecio linearifolius
		Senecio sp.
	ERICACEAE	*Gaultheria hispida*
	EPACRIDACEAE	*Leucopogon hookeri*
		Leucopogon ericoides
		Cyathodes juniperina
		Cyathodes parvifolia
	OLEACEAE	*Notelaea ligustrina*
	CONVOLVULACEAE	*Dichondra* sp.
	LABIATEAE	*Ajuga* sp.
	PROTEACEAE	*Lomatia tinctoria*
		Hakea sp.
	THYMELIACEAE	*Pimelea* sp.
	SANTALACEAE	*Exocarpus strictus*
MONOCOTYLEDONS	ORCHIDACEAE	*Pterostylis pedunculata*
		Pterostylis nutans
		Pterostylis longifolia
		Chiloglottis gunni
	LILIACEAE	*Drymophila cyanocarpa*
		Lomandra longifolia
	IRIDACEAE	*Diplarrhena moraea*
	GRAMINEAE	*Poa* sp.
	JUNCACEAE	*Luzula* sp.
		Juncus sp.
PTERIDOPHTYA	BLECHNACEAE	*Blechnum* sp.
	ASPIDIACEAE	*Asplenium flabellifolium*
	POLYPODIACEAE	*Microsorium diversifolium*
	DENNESTAEDIACEAE	*Pteridium esculentum* (Bracken)
		1 sp. unidentified
BRYOPHYTA	MUSCI	4 spp. unidentified

TABLE 3 Botanical species collected in an area of wet sclerophyll regeneration (Compartments 3 and 4) on the plateau of Maggs Mountain in September, October and November 1974. The area was burnt in 1962 following logging.

GYMNOSPERMAE	PODOCARPACEAE	*Phyllocladus asplanifolius* (Celery-topped Pine)
ANGIOSPERMAE		
DICOTYLEDONS	RANUNCULACEAE	*Ranunculus pascuinus*
		Ranunculus sp.
	WINTERACEAE	*Drimys lanceolata* (Mountain Pepper)
	VIOLACEAE	*Viola hederacea* (Violet)
	PITTOSPORACEAE	*Pittosporum bicolor* (Cheese or Tallow-wood)
	LEGUMINOSAE	*Acacia dealbata* (Silver Wattle)
		Pultenea juniperina (Prickly Beauty)
	ROSACEAE	*Rubus fruticosus* (Blackberry sp.)
		Acaena sp. (Buzzy)
	MYRTACEAE	*Eucalyptus delegatensis* (Gum-topped Stringybark)
		Eucalyptus viminalis (White or Manna Gum)
	RUBIACEAE	*Coprosma nitida*
	COMPOSITAE	*Senecio linearifolius* (Fire-weed)
	EPACRIDACEAE	*Cyathodes parvifolia* (Pink Mountain Berry)
	OLEACEAE	*Notelaea ligustrina* (Native Olive)
	PROTEACEA	*Hakea* sp.
		Telopea truncata (Warratah)
		Lomatia tinctoria (Guitar Plant)
	THYMELIACEAE	*Pimelea drupacea*
	FAGACEAE	*Nothofagus cunninghamii* (Myrtle)
MONOCOTYLEDONS	ORCHIDACEAE	*Chiloglottis gunnii*
	LILIACEAE	*Drymophila cyanocarpa*
	GRAMINEAE	*Poa* sp.
	JUNCACEAE	*Luzula oldfieldii*
		Juncus sp.
PTERIDO*PHYTA*	DENNSTAEDTIACEAE	*Pteridium esculentum* (Bracken)
	ASPIDIACEAE	*Polystichum* sp.
	BLECHNACEAE	*Blechnum penna-marina*
		Blechnum fluviatile
	LYCOPODIACEAE	*Lycopodium fastigiatum*
BRYOPHYTA	MUSCI	4 spp. unidentified

TABLE 4 A list of the botanical specimens collected in February, 1976 from Compartment 2, an area of clear-cut on the plateau of Maggs Mountain which was burnt in February, 1975. Relative abundance at the time of collection is indicated: A = abundant, F = frequent, O = occasional.

PTERIDOPHYTA	LYCOPODIACEAE	*Lycopodium fastigiatum*	O
	FILICINAE	*Pteridium esculentum*	A
		Polystichum proliferum	F
MONOCOTYLEDONS	LILIACEAE	*Drymophila cyanocarpa*	O
	JUNLACEAE	*Luzula campestris*	O
		Juncus sp.	F
	ORCHIDACEAE	*Chiloglottis* sp.	O
	GRAMINEAE	*Agrostis parviflora*	O
		Agropyron pectinatum	A
		Echinopogon ovatus	F
		Poa sp.	O
		5 unidentified grass spp.	FFOFO
DICOTYLEDONS	RANUNCULACEAE	*Ranunculus scapigerus*	A
	CRUCIFERAE	*Cardamine tenuifolia*	O
		1 unidentified sp.	O
	VIOLACEAE	*Viola sieberiana*	A
	CARYOPHYLLACEAE	*Scleranthus biflorus*	O
	HYPERICACEAE	*Hypericum japonicum*	O
	GERANIACEAE	*Geranium* (*molle*?)	A
		Geranium potentillioides	O
	OXALIDACEAE	*Oxalis corniculata*	A
	LEGUMINOSAE	*Pultenea juniperina*	O
	ROSACEAE	*Acaena* (*novaehollandiae*?)	O
	ONAGRACEAE	*Epilobium* sp.	F
	UMBELLIFERAE	*Hydrocotyle sibthorpioides*	O
		Asperula gunnii	O
		Galium gaudichaudii	O
	COMPOSITAE	*Lagenophora stipitata*	O
		Olearia ramulosa	O
		Olearia (*stellulata*?)	O
		Helichrysum scorpioides	A
		Gnaphalium collinum	A
		perhaps a second sp.	O
		Senecio linearifolius	F
		Senecio vellioides	A
		Senecio jacobea	A
		Taraxacum officinale	O
		Crepis capillaris	O
		Hypochaeris radicata	A
		Cotula alpina	O
	CAMPANULACEAE	*Wahlenbergia consimilis*	F
	EPACRIDACEAE	*Cyathodes parvifolia*	O
	GENTIANACEAE	*Gentianella diemensis*	O
	SCROPHULARIACEAE	*Veronica* sp.	O
	POLYGONACEAE	*Rumex acetosella*	O
	PROTEACEAE	*Lomatia tinctoria*	F
	THYMELIACEAE	*Pimelea* sp.	O
	EUPHORBIACEAE	*Poranthera microphylla*	O
	URTICACEAE	*Urtica urens*	O
		2 seedlings Dicotyledons not identified	OO

TABLE 5 Mammal species recorded at Maggs Mountain, 1974-1976, showing relative abundance in five different habitats.

x = rare xx = uncommon xxx = common xxxx = abundant

Species	Rainforest	Wet sclerophyll forest	Dry sclerophyll forest	Plateau regeneration	Grassland and plateau clear-cut
Brush Wallaby	x	xxx	xxxx	xxx	xxxx
Tasmanian Pademelon	xx	xxxx	xx	xx	xx
Southern Potoroo		xxx	xxx		
Brush-tailed Possum	x	xxxx	xxxx	xxxx	xxx
Common Ringtail	x	xx	xx	x	
Sugar Glider	x	x	x		
Eastern Pigmy Possum		x			
Common Wombat	x	xx	xx	xx	xx
Brown Bandicoot		xx	xx		
Tiger Cat		x	x		
Tasmanian Devil		x	x		
Dusky Antechinus	xx	x			
Water Rat		x	x		
Eastern Swamp Rat	xxxx	xxxx	xxx	xxx	
Long-tailed Rat	xxx	x			xx
House Mouse		xx	xx	x	xxx
Rabbit		x	xxx	x	xxxx
Lesser Long-eared Bat			x		
Little Bat			x		
Tasmanian Pipistrelle			x		
Cat		x	x	x	x
Echidna	x	xx	xxx	xx	xx

TABLE 6 Bird species recorded in the Maggs Mountain study area, 1974-1976 giving relative abundance at the time of peak population in six habitat types. - = not present, 0 = not recorded but may be present, 1 = 1-5 in the study area, 2 = 6-20 in the study area, 3 = 1 to 2 recorded per hour, 4 = 3-5 per hour, 5 = 6-10 per hour, 6 = 11-20 per hour, 7 = 21-50 per hour, 8 = 51-100 per hour, 9 = 100 plus per hour.

Species	Rainforest	Wet sclerophyll forest	Dry sclerophyll forest	Plateau regeneration	Grassland and plateau clear-cut	River or valley swamp
Black Cormorant	-	-	-	-	-	1
White-faced Heron	-	-	0	-	0	1
Black Duck	-	-	0	-	1	1
Brown Goshawk	-	1	1	0	0	-
Wedge-tailed Eagle	0	1	1	0	0	-
Peregrine Falcon	0	1	1	0	0	-
Brown Falcon	-	0	1	0	1	-
Spotless Crake	-	-	-	-	-	2
Tasmanian Native-Hen	-	-	1	-	0	1
Masked Plover	-	-	-	-	0	1
Brush Bronzewing	-	1	1	0	0	-
Yellow-tailed Black Cockatoo	2	2	2	2	2	-
Sulphur-crested Cockatoo	1	1	1	1	1	-
Green Rosella	3	5	5	4	5	-
Blue-winged Parrot	-	-	0	-	2	-
Fan-tailed Cuckoo	0	3	4	0	0	0
Shining Bronze Cuckoo	0	4	5	3	3	0
Tawny Frogmouth	-	0	1	0	0	-
Kookaburra	-	0	2	2	0	-
Welcome Swallow	-	0	5	0	0	-
Tree Martin	-	0	6	0	4	-
Richard's Pipit	-	-	0	-	2	-
Black-faced Cuckoo-shrike	0	4	4	0	0	-
Scaly Thrush	3	3	2	0	-	-
Pink Robin	3	3	0	0	-	-
Flame Robin	-	4	7	4	6	-
Scarlet Robin	-	0	4	0	0	-
Dusky Robin	-	0	5	0	4	-
Olive Whistler	3	5	4	3	-	-
Golden Whistler	-	3	5	0	0	-
Grey Shrike-thrush	-	5	5	4	3	-
Satin Flycatcher	-	0	6	0	0	-
Grey Fantail	4	5	6	0	0	-
Spotted Quail Thrush	-	0	3	0	0	-
Superb Blue Wren	-	4	7	5	7	4
Southern Emu-wren	-	-	-	-	-	2
White-browed Scrubwren	4	5	4	3	3	0
Scrubtit	3	1	-	0	-	-
Fieldwren	-	-	-	-	2	-
Brown Thornbill	-	3	6	3	5	-
Tasmanian Thornbill	5	6	3	6	3	-
Yellow Wattlebird	3	4	7	6	3	-
Yellow-throated Honeyeater	0	6	7	7	4	-
Strong-billed Honeyeater	-	5	7	4	-	-
Black-headed Honeyeater	-	0	8	-	-	-
Crescent Honeyeater	3	6	5	4	1	-
Eastern Spinebill	4	4	6	0	0	-
Spotted Pardalote	0	0	5	0	0	-
Striated Pardalote	3	4	8	5	5	-
Silvereye	0	7	9	0	5	-
European Goldfinch	3	4	5	3	8	-
Beautiful Firetail	0	4	5	0	3	-
Common Starling	-	-	2	-	-	-
Dusky Woodswallow	-	-	5	-	-	-
Black Currawong	3	8	8	8	8	-
Forest Raven	0	3	4	3	3	0

TABLE 7 The status, seasonal occurrence and relative abundance of birds recorded in the Maggs Mountain study area from September 1975 to August 1976. T = transient, R = resident, M = interstate migrant, AM= altitudinal migrant, B = breeds locally, O = insufficient data available. The index numbers are given to indicate the relative abundance of each species as recorded on each monthly visit. - = not present, 0 = not recorded but may be present, 1 = 1-5 in the study area, 2 = 6-20 in the study area, 3 = 1-2 recorded per hour, 4 = 3-5 per hour, 5 = 6-10 per hour, 6 = 11-20 per hour, 7 = 21-50 per hour, 8 = 51-100 per hour, 9 = 100 plus per hour.

Species	Status	July	August	September	October	November	December	January	February	March	April	May	June
Black Cormorant	T	0	0	0	0	0	1	1	1	0	0	0	0
White-faced Heron	T	0	0	0	0	0	0	0	0	1	0	0	0
Black Duck	T	0	0	1	0	0	0	1	0	0	0	0	0
Brown Goshawk	OB	0	0	1	1	1	0	0	0	0	0	0	0
Wedge-tailed Eagle	RB	0	1	1	0	0	1	1	1	1	0	1	0
Peregrine Falcon	O	0	1	0	0	0	0	0	0	0	0	0	0
Brown Falcon	RB	0	0	1	1	0	0	1	1	1	0	1	1
Spotless Crake	RB	0	0	0	0	0	0	0	0	0	2	0	0
Tasmanian Native Hen	RB	1	1	0	0	1	0	1	1	1	1	1	1
Masked Plover	T	0	1	1	0	0	0	0	1	1	0	0	0
Brush Bronzewing	O	0	0	1	0	0	0	1	0	0	0	0	0
Yellow-tailed Black Cockatoo	RB	2	2	2	2	0	2	0	0	2	2	0	2
Sulphur-crested Cockatoo	RB	0	0	1	1	1	1	1	1	1	0	0	0
Green Rosella	RB	4	4	5	5	5	5	5	5	5	5	5	5
Blue-winged Parrot	M	-	-	-	-	-	-	0	2	2	0	-	-
Fan-tailed Cuckoo	MB	-	-	1	4	4	4	4	3	0	-	-	-
Shining Bronze-cuckoo	MB	-	-	0	4	5	5	4	0	0	-	-	-
Tawny Frogmouth	O	0	0	0	1	0	0	0	0	0	0	0	0
Kookaburra	RB	2	2	2	2	2	2	2	2	2	0	0	0
Welcome Swallow	MB	-	-	2	3	4	5	4	5	0	-	-	-
Tree Martin	MB	-	-	4	4	5	6	6	5	3	3	0	-
Richard's Pipit	AMB	-	-	1	0	0	1	0	2	1	0	-	-
Black-faced Cuckoo-shrike	MB	0	0	2	3	4	4	3	0	0	0	0	0
Scaly Thrush	RB	0	3	0	0	0	0	0	0	0	3	3	0
Pink Robin	RB	3	3	0	0	3	0	3	0	3	3	3	3
Flame Robin	MB	-	5	7	7	4	5	4	5	6	6	4	-
Scarlet Robin	AM	3	3	2	0	0	0	2	0	3	3	4	3
Dusky Robin	RB	4	4	4	4	4	4	5	4	4	4	5	4
Olive Whistler	RB	0	3	5	4	0	3	5	3	4	3	3	0
Golden Whistler	RB	3	3	4	5	4	5	3	3	3	3	3	0
Grey Shrike-thrush	RB	4	4	5	5	5	4	5	4	5	5	4	4
Satin Flycatcher	MB	-	-	-	0	6	6	6	6	3	0	-	-
Grey Fantail	MB	2	0	3	6	5	5	5	4	6	3	4	2
Spotted Quail-thrush	RB	0	0	0	0	0	0	0	0	3	0	3	0
Superb Blue Wren	RB	5	5	5	6	5	5	5	5	7	7	7	7
Southern Emu-wren	RB	0	0	1	0	1	2	2	2	2	2	1	1
White-browed Scrubwren	RB	5	5	5	5	5	4	4	4	5	5	5	5
Scrubtit	RB	0	0	3	3	3	0	3	3	3	0	3	0
Fieldwren	RB	0	0	0	0	0	0	2	2	2	2	2	2
Brown Thornbill	RB	5	5	6	6	4	4	4	4	5	6	6	6
Tasmanian Thornbill	RB	5	5	6	6	4	4	4	4	5	6	6	6
Yellow Wattlebird	AMB	3	4	7	5	4	5	4	5	6	3	3	3
Yellow-throated Honeyeater	RB	4	5	7	5	6	5	6	5	5	5	5	6
Strong-billed Honeyeater	RB	5	6	7	4	5	6	4	6	4	4	7	7
Black-headed Honeyeater	RB	6	6	7	7	6	6	6	8	7	7	6	7
Crescent Honeyeater	AMB	0	3	6	4	6	0	3	3	5	0	3	3
Eastern Spinebill	AMB	0	3	6	4	4	3	4	4	4	3	3	0
Spotted Pardalote	RB	4	5	4	3	3	3	3	3	4	3	3	3
Striated Pardalote	MB	0	5	7	8	6	6	5	8	6	4	0	0
Silvereye	MB	0	0	6	9	7	6	6	8	7	6	0	0
European Goldfinch	RB	5	5	4	4	4	4	4	5	5	8	4	4
Beautiful Firetail	RB	4	4	3	4	3	4	3	4	4	5	4	4
Common Starling	T	-	-	-	0	2	0	-	-	-	-	-	-
Dusky Woodswallow	MB	-	-	2	2	4	4	3	5	4	0	-	-
Black Currawong	RB	4	5	6	7	8	4	4	4	3	3	3	3
Forest Raven	RB	3	3	4	3	3	3	3	3	3	3	3	3

TABLE 8 Amphibian and reptile species recorded at Maggs Mountain, 1974-1976 showing relative abundance in five different habitats.

x = rare xx = uncommon xxx = common xxxx = abundant

Species	Rainforest	Wet sclerophyll forest	Dry sclerophyll forest	Plateau regeneration	Grassland and plateau clear-cut
Brown Tree-frog	x	xxx	xxxx	xxxx	xxxx
Smooth Froglet			Borradaile Plains		
Brown Froglet	x	xxx	xxx	xxx	xxx
Tasmanian Froglet	xx	xxx	xxx	xxx	xxx
Metallic Skink		x	xxxx	x	xxxx
Spotted Skink			x		
Small-scaled Skink		x	xx	xxxx	xx
She-oak Skink		xx	xx	xx	
Southern Blue-tongue Lizard		xx	xxx	xx	xx
White-lipped Snake		xx	xxx	xx	xx
Tasmanian Tiger Snake	x	xxx	xxx	xx	xx

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PLEISTOCENE CAVE MATERIAL OF TASMANIAN NATIVE-HEN *TRIBONYX MORTIERII* AND SOOTY SHEARWATER *PUFFINUS GRISEUS* IN TASMANIA

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Breccias containing mainly mammalian but also traces of avian and reptilian material were found in Pleisto Scene Cave (MU-206) 144° 54'E, 40° 54'S, near Montagu, northwestern Tasmania (Murray and Goede 1977), and in Beginners Luck Cave (JF-79-80) 146° 28'E, 42° 34'E, in the Florentine Valley, Tasmania (Goede and Murray 1977).

In age the breccias are considered to be contemporaneous with or older than the last rise in sea level about 10,000 BP, which separated Tasmania from mainland Australia. Charcoal and human artefacts have been found in the breccia of Beginners Luck Cave but not in that of Pleisto Scene Cave.

The non-ratite avian material at both caves includes complete and fragmented bones of the Tasmanian Native-hen *Tribonyx mortierii* (see Table 1). Measurements are as recommended in Scarlett (1972). They do not differ significantly from those given for recent material in Olson (1975) except for the proximal end of the tibiotarsus which he has measured differently and in unspecified manner. The Tasmanian Native-hen lives in open grassy areas near water (Ridpath 1972). Its range is now restricted to Tasmania. In Pliocene and Pleistocene times it occurred in southeastern Queensland (Olson 1975) and in recent prehistoric times at Kangaroo Island with other bird and mammal species now confined to Tasmania (Hope *et al.* in press).

At Beginners Luck Cave were found a left femur lacking the distal end and a left tarsometatarsus with damaged ends of a Sooty Shearwater *Puffinus griseus* (see Figure 1). The shaft of the femur has the bow and the shaft of the tarsometatarsus has the mediolateral flattening that characterises those of Short-tailed Shearwater *P. tenuirostris* and the Sooty Shearwater. The bones are too large for *P. tenuirostris* and the right size for *P. griseus*. The Sooty Shearwater is an uncommon breeding seabird on small islands off the shores of Tasmania and southeastern Australia (Serventy *et al.* 1971). It breeds in huge numbers on small islands around Stewart Island, New Zealand, and on many sub-antarctic islands (Kinsky 1970, Watson 1975). It is possible that the Sooty Shearwater was blown inland by a gale and its remains either washed into the cave or carried there by a predator. It is more likely, however, that it was picked up on the coast and carried to the cave by man as an ornament or as food. At the time of deposition the seas may have been cooler and the Sooty Shearwater more common around Tasmania than now.

FIGURE 1 Left tarsometatarsus and femur of *Puffinus griseus* CS.BS.1648/PROS.627 from Beginners Luck Cave (JF-79-80), flanked by modern material of left *P. griseus* CS.BS.466/PROS.420 and right *P. tenuirostris* CS.BS.613/PROS.274.

Photograph by E. Slater.

Table 1

Material of *Tribonyx mortierii* found at Pleisto Scene Cave (MU-206) and Beginners Luck Cave (JF-79)

Location and specimen number	Bone	Side	Length mm.	Proximal width mm.	Narrowest width of shaft mm.	Distal width mm.
MU-206/A	cranium					
CS.BS 1649						
/GRUS 55	synsacrum					
	femur	right			6.5	18.1
	tibiotarsus	right		19.1	6.6	
	tarsometatarsus	right			5.4	12.4
	tarsometatarsus	left		14.5		
	tarsometatarsus	right				
MU-206/B3	humerus	right			4.2	
CS.BS 1650						
/GRUS 56	carpometacarpus	right		10.8	3.7	
	tibiotarsus	right	130	16.9	6.6	
	tibiotarsus	right			6.5	
	tibiotarsus	left			5.9	
	tibiotarsus	left				
	tarsometatarsus	right			5.7	
JF-79-80/P	humerus	left	61.2	13.5	4.2	10.0
CS.BS 1651	tibiotarsus	right	121.2	17.5	6.1	11.8
/GRUS 57	tarsometatarsus	left	78.8	13.0	5.2	12.2

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PLEISTOCENE VERTEBRATE REMAINS FROM A CAVE NEAR MONTAGU, N.W. TASMANIA

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ABSTRACT

The results are presented of a study of vertebrate remains and associated sediments found in a small, recently discovered dolomite cave (MU-206) in north-western Tasmania. A list of species identified to date is presented and the geochronological and palaeoecological significance of the fossils is indicated.

A description is given of the evolutionary history of the cave and the character of the cave deposits is examined. This is supplemented by an assessment of the condition, completeness and relative position of the fossil material from the site.

PHYSICAL SETTING

Tasmania is a mountainous island with numerous small areas of karst, located predominantly in the high rainfall zone of the western half of the state.

The Montagu karst consists of two small Upper Precambrian dolomite hills rising to a maximum height of six metres above a marshy plain near the Montagu River (figure 1). It is located in the centre of an extensive coastal plain with the land sloping gently northwards towards Bass Strait. Local drainage also trends in this direction.

The area has an extensive veneer of Pleistocene and Holocene sediments ranging from shallow marine and estuarine deposits to aeolian, alluvial and paludal sediments. The Pleistocene cover is interrupted by ridges and isolated outcrops of basement rocks which are predominantly Upper Precambrian and Cambrian in age. A description of the regional geology is given by Gulline (1959). The Precambrian outcrops consist of quartzites, conglomerates and dolomites (Smithton Dolomite) and are widespread. Cambrian rocks include siltstones, tuffs, greywackes, breccias and conglomerates as well as some basic volcanic rocks.

Marine and freshwater Tertiary sediments, including limestones, are of limited extent. They are generally flat-lying in contrast to the strongly folded Precambrian and Cambrian rocks. Outcrops of Tertiary basalts occur locally but are extensive only in the south-east corner of the area shown in figure 1.

Pleistocene high sealevels are indicated by the presence of raised shorelines associated with shallow marine deposits and relict coastal dunes. Further east, three raised shorelines described by Chick (1971) are suggested to be of Last Interglacial age. The highest stands at approximately 20 metres above higher high water mark. Regression of the Pleistocene sea from maximum levels is indicated by extensive series of beach ridges. Some of the older series have been almost completely buried by subsequent peat accumulation.

Artesian springs occur locally in association with deposits of peat and freshwater algal marl. Those near Mella (Mowbray Swamp) are associated with well developed spring mounds. Both the Mowbray and Pulbeena springs are characterized by a very high carbonate content (400 p.p.m. at Mella and 750 p.p.m. at Pulbeena) indicating the presence of dolomite below the Pleistocene sediment cover. Pleistocene vertebrate remains have been recovered from both sites (Gill and Banks, 1956; Hope, 1973; Banks, Colhoun and van de Geer, 1976). Remains have also been recorded from a small dolomite cave (Scotchtown Cave) discovered near Smithton during mining operations in 1942.

The Montagu area is located approximately 41° South and 140° East. It is characterized by a mean annual temperature of approximately 13°C. The mean temperature of the warmest month (February) is close to 17°C while the mean temperature of the coldest month (July) is just above 9°C. The mean annual precipitation is 115 cm with a winter maximum. Not less than 35% of the annual precipitation falls in the three winter months (June-August) but only 15% during the three summer months (January-March).

The Montagu karst is within a wet sclerophyll forest giving way to swamp associations in poorly-drained portions of the surrounding plain. Three caves are known in the area. All contain deposits which include vertebrate remains. Main Cave (MU-201) and Pleisto Scene Cave (MU-206) are located on the western side of the Grunter Road, while the third, an unnamed cave (MU-203) is found in a dolomite outcrop on the opposite side of the road. The direction of dip of the dolomite is SW with the angle of dip varying from 35° to 58°. All the known cave entrances are located on the anti-dip side of the hills where they rise steeply from the surrounding country to form low cliff faces up to 5 metres high. The opposite south-east facing slopes merge gradually into the plain.

CAVE EVOLUTION

The caves have developed under varying groundwater levels which are probably related to past changes in sealevel as the location of the area is marginal to the estuarine plains of the Montagu River. An early stage of shallow phreatic development, related to a high groundwater level, is suggested by arched and flat roofs except where locally modified by rockfall. This appears to have been followed by a period of downcutting under vadose conditions associated with a falling water table. Much of the evidence for this phase is obscured by subsequent intermittent deposition of locally fossiliferous clastic sediments which can be subdivided into three stratigraphic units. This indicates a third phase of cave evolution at a time when groundwater levels were low. The sediments vary from mass-movement deposits containing abundant angular dolomite fragments to clay-rich water laid sediments accumulated under very low energy flow conditions in ponds and underground channels.

A subsequent period of marked but localized flowstone deposition has cemented the surface layers of the underlying clastic sediments in places. This was followed by a period of erosion which dissected some of the cave fill and undermined flowstone-cemented floors to produce "false floors" and protruding ledges. The final episode, which apparently still continues, is another period of localized flowstone deposition.

DESCRIPTION OF CAVE

The entrance is located in a jumble of rocks on a steeply rising north-facing hill slope. It measures approximately 80 cms across and has a roughly triangular shape. A 2.5 metre drop leads to a fissure about one metre wide and four metres long trending in a southerly direction. The floor consists of brown mud with some decaying wood and leaves (figure 2). A small, steeply sloping hole leads downwards about 1.5 metres, from almost directly below the entrance, to a horizontal passage. This passage shows evidence of having been almost filled with strongly-cemented, bone-bearing dolomitic breccia, remnants of which can be seen adhering to the eastern wall.

From the passage a horizontal slit 40 cms high leads to a small chamber (Chamber A) with horizontal dimensions of three by six metres and a maximum height of three metres. The chamber is located immediately below the entrance fissure and separated from it by a "false ceiling" consisting of a double layer of cemented bone-bearing breccia.

On the western side of the chamber, towards the northern end, a 1.5 metre high section of clay-rich alluvial sediments is exposed. The eastern wall appears to be composed mostly of bedrock with some flowstone. From its base extends a six metre long easterly trending passage which contains standing water in winter. It has a clay floor and a bedrock roof containing many actively growing stalactites.

From Chamber A the passage continues to a flowstone bridge. The flowstone sheet was originally formed on the upper surface of the fill sequence as indicated by the adherence underneath of fragments of strongly cemented cave sediment. Dissection of the clastic deposits after deposition of the flowstone has left it suspended above the floor of the present day passage.

At this point a north-south trending passage is entered. It is characterized by smoothly rounded ceilings and has an average height of 1.5 metres. Chamber B is located a short distance along the passage in a southerly direction. Bone-bearing dolomitic breccia is exposed both in the ceiling and the floor. The area of exposure in the ceiling is 0.5 by 2 metres and is contained within a fissure sloping upwards at an angle of approximately 50^{o}. The floor exposures consist of a dissected debris cone extensively covered with flowstone and located on the western side of the passage. At its outer margin it grades at a low angle into the upper surface of the cave fill sequence. This surface has also been dissected and is best preserved as a narrow bench on the eastern side of the passage.

The cave continues for a short distance beyond Chamber B as indicated in figure 2. Bone breccia also occurs near the furthest point reached as shown in section AA' (figure 2) but this site has not yet been excavated or sampled.

NATURE AND STRATIGRAPHY OF CLASTIC SEDIMENTS

A stratigraphic sequence of the deposits is best seen in Chamber A although the base is not exposed (figure 3). Three sedimentary units can be identified. Lowest in the sequence are 1.5 metres of clay rich, fine-grained alluvial sediments (Bed 1) seen in section on the western side of the chamber. At the base the deposits are reddish brown (5YR/4/8) grading upwards into yellowish brown sediments (10YR/5/6) which make up the bulk of the deposit (Japanese Revised Standard Soil Color Charts). The top 40 cms are dark reddish brown (5YR/3/4) and appear to represent a fossil soil (Bed 1 soil). This material is rich in colloidal organic matter but an attempt at pollen extraction was not successful. It also contains sporadic angular dolomite fragments. Small fragments of bone are dispersed throughout but are poorly preserved. The pH varies from 8.5 to 9.0.

The sediments just described are overlain by a dolomite breccia up to 50 cms thick (Bed 2) with a sharp depositional contact. Bed 2 is strongly cemented and forms a projecting shelf making up part of the roof. As well as bones, it contains numerous angular dolomite fragments down to only a few millimetres across. Most of the material has a sparse matrix of fine-grained sediment but locally an open framework occurs. The nature of the material suggests strong physical weathering, probably by frost.

The highest part of the roof exposes the base of the upper unit (Bed 3), which is also a dolomite breccia. Its thickness cannot be measured directly but must be less than one metre. It is also strongly cemented and contains abundant fossil vertebrate remains. The sub-angular dolomite fragments it contains are coarser than in the underlying layer and generally range from 1 to 10 cms in diameter with a few large blocks of up to 40 cms. It also contains a much more abundant matrix of fine-grained sediment. The nature of the dolomite fragments again indicates derivation by physical weathering but under less extreme conditions.

Most of the excavations have taken place in Chamber B where the stratigraphy is less clearly exposed. At an early stage of the excavations material excavated from the roof was kept separate from that excavated from the floor and debris cone. On analysis of the material it became apparent that both contained the same fauna and that the deposits were of the same nature. In subsequent excavations specimens from the two sites were combined.

The sediments excavated from both roof and floor sites in Chamber B are very similar in nature to Bed 3 in Chamber A and occur in the same stratigraphic position. Henceforth they will be referred to as Bed 3B. However, a few scattered, water-rounded quartz pebbles were found as well as one water-rounded quartz crystal and a number of strongly lateritized non-carbonate sedimentary rock fragments. One of the fragments contained a fossil pectinid *Mesopeplum antecedens* (Singleton) - a Tertiary marine fossil reasonably common in the Janjukian and Longfordian (Darragh, T. A., pers. comm.). It has probably been derived from a Tertiary cover rock which has since been eroded. The sediments are mostly bright brown (7.5YR/5/6) and have a pH of 9. Bed 2 does not seem to be represented in Chamber B where Bed 3B rests directly on a lower unit of fine-grained alluvial sediments containing some poorly preserved bone material (Bed 1B).

Beds 2 and 3 represent typical entrance facies deposits which were derived from surface openings under conditions favouring mechanical weathering and mass movement and were transported by solifluction processes to be deposited as sloping sheets and debris fans. The absence of Bed 2 in Chamber B suggests that the surface opening which would have allowed its accumulation was not yet in existence at the time of its accumulation in Chamber A.

DISCUSSION

Bed 1 appears to represent aggradation by a slow-moving vadose stream. It may mark the onset of cold conditions early in the Last Glaciation resulting in soil instability and consequently an increase in sediment load. When accumulation ceased it appears to have been followed by a period of stability perhaps reflecting a return to milder climatic conditions. This is indicated by the fossil soil developed on Bed 1 in Chamber A. Some bones appear to have accumulated on this surface. Two upper incisors probably belonging to *Palorchestes* sp.[1] fall into this category.

Bed 2 is a dolomite breccia representing an entrance facies deposit. The abundance of small angular fragments of dolomite and the occurrence of open framework material indicate strong frost weathering. The sediment has all the characteristics of a solifluction deposit and suggests accumulation under surface conditions with an open and discontinuous vegetation cover, at least at the dolomite outcrops.

It has been observed that dolomites of similar age, cropping out further south (42° 57' S) and in a more continental situation near Mount Anne at altitudes of up to 1000 metres, are not at present subject to active frost weathering in winter. Therefore, frost weathering at the Montagu cave site would seem to require a lowering of winter temperatures equivalent to an altitudinal lowering of winter temperature zones of not less than 1200 metres. This corresponds to a reduction in the mean winter temperature of 8°C (Haltiner and Martin, 1957). It suggests that Bed 2 accumulated under conditions approaching maximum cold during the Last Glaciation.

Bed 3 is similar in origin to the middle unit but appears to have accumulated under less extreme cold climate conditions. The dolomite fragments are larger and there is a much greater abundance of fine-grained matrix. In both Chambers A and B this sediment is rich in fossil bone material and the fossil bone material excavated in Chamber B comes from this bed.

EXCAVATION METHODS

Chamber B locality of Pleisto Scene Cave has been extensively sampled. Small samples have been obtained from Chamber A in the same cave, and from one of

1 Positive identification of *Palorchestes* from Chamber A is based on a lower incisor.

several deposits in nearby Main Cave (MU-201). Another Montagu locality, (MU-203), yielded a small but interesting collection of fossils. Three types of fossiliferous matrix were encountered in Bed 3B. An extremely durable breccia was broken into pieces so that it could be transported through the narrow passages to the surface. Fossils were freed from thick flowstone rinds and a durable, calcined cave fill with the aid of an air hammer. Other fossils were obtained by exposing them in the softer fill of the floor of the cave.

The high clay content of the fill hampered attempts to employ screening. Bulk samples of fill were thus removed to the laboratory. A slurry of sediment and water was passed through a fine screen in order to sample small mammal remains.

The cave fill was methodically explored for fossil remains. The position and orientation of important individual finds and large concentrations of fossils were recorded in the field. Considerable amounts of fill and matrix remain undisturbed for further reference.

FAUNAL COMPOSITION

The fauna consists primarily of living and extinct species of macropodids. The Macropodinae are represented by *Thylogale* (indistinguishable from *billardieri*), *Macropus* (indistinguishable from *rufogriseus*), *Macropus titan* and the extinct wallaby *Protemnodon anak*. The Sthenurinae are represented by a large sample of *Sthenurus occidentalis* mandibles and maxillae. *Sthenurus* remains were second in frequency to those of *Thylogale billardieri* (figure 4b). *Macropus titan* and *Protemnodon anak* were rare. *Macropus rufogriseus* fossils were more common than *M. titan* and *P. anak* combined. Specimens of *Perameles gunnii* are also relatively common. While few individuals of *Vombatus ursinus* were present, the species provided some of the best preserved cranial remains from the site. The remaining eight species are represented by only one or two individuals each. Two individuals of *Zaglossus* sp. including one nearly complete specimen in partial articulation are among the more interesting fossils from the locality.

Sarcophilus harrisii is represented by a single canine tooth. The tooth is within the range of modern Tasmanian devils. A mandible of *Thylacoleo carnifex* from the "floor" site of Chamber B is the second example of this species recovered in Tasmania. The first specimen was found in Scotchtown Cave (Gill, 1954; Gill and Banks, 1956). A single individual each of *Potorous tridactylus*, *Mastacomys fuscus*, *Hydromys chrysogaster*, diprotodontids ?*Zygomaturus*, *Palorchestes* and an otariid, (*Neophoca* sp.), represented by a lower canine, $P_{\bar{4}}$ and ?$M_{\bar{1}}$ (figure 5c) comprise the remainder of the fauna.

DETERMINATION OF THE EXTINCT SPECIES

This description is intended to give information sufficient to justify the species determinations presented. Detailed descriptions of the fauna are in progress for *Zaglossus* sp. and the Tasmanian Sthenurines.

MACROPODINAE

Macropus (Macropus) Shaw

Macropus (*Macropus*) sp.

Material: Juvenile left maxilla fragment containing P^2 unerupted P^3, DP^3 and M^1 (figure 6i, j).

Description: Slightly worn P^2, dumbell-shaped in outline, paracone smaller than metacone, separated by a deep lingual and shallow labial constriction, metacone and paracone joined on the labial side by a bifid crest that continues anteriorly into a preparacrista; small posterior cingulum unites with hypocone, crista connects anterior part of hypocone to posterior third of metacone; metastyle present on labial side. Slightly worn DP^3, molariform; high, relatively narrow anterior cingulum sloping lingually; lingual fossette usually present in *M. giganteus* reduced to a crease; midlink strong, expanded lingually and labially in its central portion; lingual valley narrower than in *M. giganteus*. Unerupted P^3, dumbell-shaped in occlusal outline; paracone separated from metacone by a well defined labial and shallow lingual constriction that divides the longitudinal crest extending between the two cusps; paracone comprises anterior third of tooth; prominent low cusp is present on the lingual side of the paracone (absent in

M. giganteus sample employed here); crista connects metacone to hypocone, hypocone relatively larger than forms of *M. giganteus* sample; shallow posterior fovea formed by the posterior cingulum. Slightly worn M^1, morphology as for *M. giganteus* except for narrower anterior cingulum and reduction of the lingual fossette, probably as a result of wear.

The specimen is difficult to assign due to its intermediate size between *M. giganteus* and *M. titan* (Table 1). The apparently relatively larger P^2, P^3

Table 1. Measurements of maxillary dentitions

	P^2		P^3		DP^3		M^1	
	Length	Max. width	Length	Max. width	Length	Width prot.	Length	Width prot.
Montagu	8.1	5.9	8.9	5.0	9.5	7.5	10.8	8.0
M. giganteus, Tas.	-	-	-	-	9.1	7.2	10.7	8.3
M. giganteus, Tas.	7.5	5.5	8.2	3.9	9.4	7.1	11.3	8.2
M. giganteus	6.3-	4.2-	6.6-	3.1-	7.8-	5.8-	8.7-	6.7-
(Bartholomai, 1975)	7.7	5.4	8.3	4.8	9.5	7.1	11.0	8.6
M. titan, QL.	9.2-	6.6-	8.5-	4.8-	10.1-	7.9-	10.6-	8.2-
(Bartholomai, 1975)	9.8	7.3	11.6	6.3	11.8	9.3	14.7	10.7

and DP^3 to M^1 ratio in the Montagu specimen is not significantly different from either species (Table 2).

Table 2. Ratios of lengths of maxillary dentitions

	P^2 / M^1	DP^3 / M^1	P^3 / M^1
Montagu	.75	.88	.82
M. giganteus, Tas.	-	.85	-
M. giganteus, Tas.	.66	.83	.79
M. giganteus, QL.	.70-	.86-	.76-
(Bartholomai, 1975)	.72	.90	.96
M. titan	.87-	.80-	.79-
(Bartholomai, 1975)	.92	.95	.80

A possible difference is in the ratios obtained for the maximum width of the same teeth (Table 3).

Table 3. Ratios of width of protoloph of maxillary dentitions

	P^2 / M^1	DP^3 / M^1	P^3 / M^1
Montagu	.74	.94	.63
M. giganteus, Tas.	-	.87	-
M. giganteus, Tas.	.67	.87	.48
M. giganteus, QL.	.63-	.83-	.46-
(Bartholomai, 1975)	.63	.87	.56
M. titan, QL.	.68-	.87-	.58-
(Bartholomai, 1975)	.80	.96	.59

In this regard the Montagu specimen resembles *Macropus titan* by having slightly higher ratios for all teeth measured than *M. giganteus*. The marginally more robust dentition, the presence of a well developed metastyle on the P^2, the lingual cusp on the paracone of P^3 and the slightly higher anterior cingulum suggest that the individual may be a very small *Macropus titan*. Differentiation

of the two species is problematical because they are morphologically very similar. Bartholomai (1975: 205) found minor character differences for the lower dentitions but not the uppers. The major difference is size.

Macropus (*Macropus*) *titan*, Owen 1838

Material: Unworn fragment of left I_1, fragment of the anterior portion of a juvenile mandible containing a partially erupted I_1 and slightly worn P_2 (figure 6c, g, h).

Description: I_1 unworn, morphologically similar to *M. giganteus*, deep and thick; diastema very short (25.0 mm) due to the young age of the individual; symphysis deep, rugose; P_2 convex lingually; ridged anterior cuspid gives rise to a short longitudinal crest; crest terminating in a well-developed posterolabial cuspid; small cuspule present low on the crown in the mid lingual area; large posterolabial cusp formed by cristid extending from the small cuspule. The specimen is within the size range for *Macropus titan* (Table 4).

Table 4. Measurements of the mandibular dentition of *M. titan* (mm)

	$I_{\bar{1}}$		$P_{\bar{2}}$	
	Depth	Thickness	Length	Max.width
Montagu	12.2*	6.5*(est)	8.1	4.6
M. giganteus, Tas.	9.5	5.2	6.2	3.0
M. giganteus, Tas.	10.0	5.2	-	-
M. giganteus, QL. (Bartholomai, 1975)	-	-	5.3-7.0	2.8-4.0
M. titan, QL. (Bartholomai, 1975)	-	-	7.3-9.0	3.6-4.9
M. titan, Tas.	13.5	7.5	-	-

* Less than maximum as incisors are partially erupted

Protemnodon, Owen 1874
Protemnodon anak, Owen 1874

Material: Two right juvenile hemimandibles containing P_2, DP_3, M_1: right and left juvenile hemimandibles containing DP_3, M_1, M_2; juvenile maxilla with right and left P^2, DP^3, M^1, M^2; two isolated right second lower premolars and three incisors (figure 6a, b).

Description: P^2 oval in occlusal outline, paracone less broad than metacone; labial cingulum ascends apex of paracone producing an oblique, sharply defined ridge on the anterolabial side of the tooth; mid-labial side of tooth concave; short, strong sparsely decorated metacrista joins paracone and metacone; small shallow anterolingual fossette continuous with broader shallow fossette sub-round in shape; hypocone well developed, connected by an obliquely directed crista to the metacone; lingual cingulum low, constricted, defining the paracone and metacone. DP^3 molariform, sub-trapezoidal in occlusal outline; anterior cingulum low, sloping lingually; forelink absent; labial ridge ascends paracone as a continuation of the anterior cingulum; anterior fossette shallow, widest labially; metaloph broader but more compressed mesoidistally than protoloph; midlink rather low, weak, ascends protocone from mid-inferior portion of metaloph; paracone and metacone connected by a crest defined by a faint crease on the inner side of the cusps. M^1 nearly rectangular in outline, metaloph is slightly broader than protoloph; lophs relatively higher than in DP^3; forelink absent; anterior cingulum broad, low, somewhat sinuous, forming a shallow fossette.

Metaloph more curved than protoloph; Midlink moderately high; median valley deeper and narrower on the lingual side; posterior cingulum well developed with a small fossette near the base of the middle of the metaloph. P_2 suboval in outline, twice as long as wide, planar or slightly concave lingually; labial side convex; mesial and distal cuspids joined by a ridge decorated with three small enamel bulges; bulges separated by corresponding broad, shallow grooves lingually; cingulum defines a small crease or fossette anterolabially as it ascends the paraconid. DP_3 molariform, subtriangular in occlusal outline, hypolophid broader than protolophid; anterior cingulum moderately high; forelink high and prominent, curving slightly to ascend the protoconid from the labial side of the anterior cingulum; small labial and large lingual fossettes are present; midlink is low, weak, ascends hypoconid from a point slightly lateral to the mid point of the base of the protolophid; weak posterior cingulum. M_1 rectangular in outline; anterior cingulum broad; strong, short forelink expands distally from near the midline to ascend the protoconid; large labial fossette and larger lingual fossette are present on either side; protolophid and hypolophid approximately equal in width; midlink low; weak posterior cingulum.

Table 5. Measurements of upper and lower dentitions of *Protemnodon anak*

	$P^{\frac{2}{2}}$			$DP^{\frac{3}{3}}$		$M^{\frac{1}{1}}$	
		Length	Max. Width	Length	Width Prot.	Length	Width Prot.
Montagu	-	11.7	8.0	11.0	9.1	12.5	10.5
P. anak	-	11.6-	6.3-	10.7-	8.0-	10.7-	9.1-
(Bartholomai, 1973)	-	13.5	7.5	11.8	8.8	13.3	11.2
	$I_{\bar{1}}$	$P_{\bar{2}}$		$DP_{\bar{3}}$		$M_{\bar{1}}$	
	Depth	Length	Max. Width	Length	Width Prot'd	Length	Width Prot'd
Montagu	13.1	10.5	5.1	10.1	6.0	12.2	8.1
P. anak	12.8-	10.2-	4.6-	9.0-	5.3-	10.4-	6.9-
(Bartholomai, 1973)	16.3	11.8	5.7	11.8	6.6	13.5	8.6

Prot. = protoloph; Prot'd = protolophid

The specimens of *Protemnodon* from Montagu conform closely to Bartholomai's (1973) description of the species. *Protemnodon anak* is also known from Scotchtown Cave, Smithton and King Island.

STHENURINAE

Sthenurus, Owen 1874
Sthenurus (*Simosthenurus*), Tedford, 1966
Sthenurus (*Simosthenurus*) *occidentalis*, Glauert 1910

Material: Right and left juvenile hemimandibles, left and right adult hemimandibles, nearly complete adult mandible (all with complete dentitions); left maxillary fragment with P^3, M^{3-4}; right temporal process of zygomatic arch; left M^{3-4}, left P^3, M^{3-4}; ?I1-3 (isolated); two lower incisors; isolated left P_3, two isolated right second premolars; metatarsals IV, one left and two right; probable postcranial material unassociated; (figure 7a, b, c.).

Description: These sthenurines can be differentiated from *Sthenurus* (*Simosthenurus*) *orientalis* (Tedford, 1966) on the basis of their 1) smaller size; 2) possession of a short anterior cingulum; 3) symphyseal union not extending posterior to P_3;

4) anterior root of the ascending ramus intersects the protolophid or is anterior to M_4 rather than posterior to it. The largest and most complete mandible is 156.5 mm maximum length. The height of the horizontal ramus posterior to M_4 is 47.3 mm. The dentitions are indistinguishable from *S. occidentalis* except for a slight proportional difference between length and width of the molars and a proportionally smaller P_3. They resemble *Sthenurus orientalis* only in respect to the relative decrease in the size of the P_3 to the molars.

Table 6. Measurements of the lower dentitions of *Sthenurus*

	P_3				M_1			M_2			M_3			M_4		
	L	AW	PW	HC	L	AW	PW	L	AW	PW	L	AW	PW	L	AW	PW
Montagu	15.1	7.2	10.0	8.5	10.7	9.5	9.9	11.7	10.5	10.6	12.8	11.1	11.0	12.0	11.0	9.9
Sthenurus occidentalis 45093(MC)	16.1	8.1	10.7	10.4	12.3	9.1	9.5	12.6	10.1	10.2	13.1	10.5	10.6	12.3	10.3	9.8
Sthenurus orientalis AMF 10201 (Tedford 1966)	17.0	7.9	10.7	8.4	14.0	10.9	11.2	15.0	12.2	12.7	15.2	13.0	13.2	14.6	12.7	12.1

L = length; AW = anterior width; PW = posterior width

DIPROTODONTIDAE

? *Zygomaturus* and *Palorchestes* sp.

Material: Fragment of left mandible with P_3 (figure 6f); right I_1.

Description: P_3 exhibits light wear on the paraconid; the tooth is subtriangular in occlusal outline; large paraconid comprises the anterior half of the tooth; protoconid extends approximately half as high as the paraconid, metaconid lower than protoconid; faint ridge defines a forelink that descends abruptly into a weak anterior cingulum; prominent bifid crest connects paraconid to protoconid; a low rounded crest descends from lingual side of paraconid to form a broad shelf on the metaconid; posterior cingulum low and broad; ectocingulum descends from protoconid extending to base of paraconid; labial side superior to the ectocingulum is distinctly concave.

Table 7. Measurements of ? *Zygomaturus* P_3

Length	Maximum Width	Height Crown
16.7	14.1	14.1

The specimen is similar to but smaller than P_3's of *Zygomaturus tasmanicum* (? = *trilobus*) from King Island and Mowbray Swamp (identified as *Nototherium victoriae* and *N. tasmanicum* in the Queen Victoria Museum collection). It is considerably wider than any species of *Palorchestes* but is within the range of *P. azeal* for length. This greater width is due to the triangular outline of the tooth which contrasts with the oval outline of palorchestine lower premolars. The possibility of the tooth being a Dp_3 is ruled out by the absence of a developing P_3 crown and by the long, stout roots which extend down to the incisor

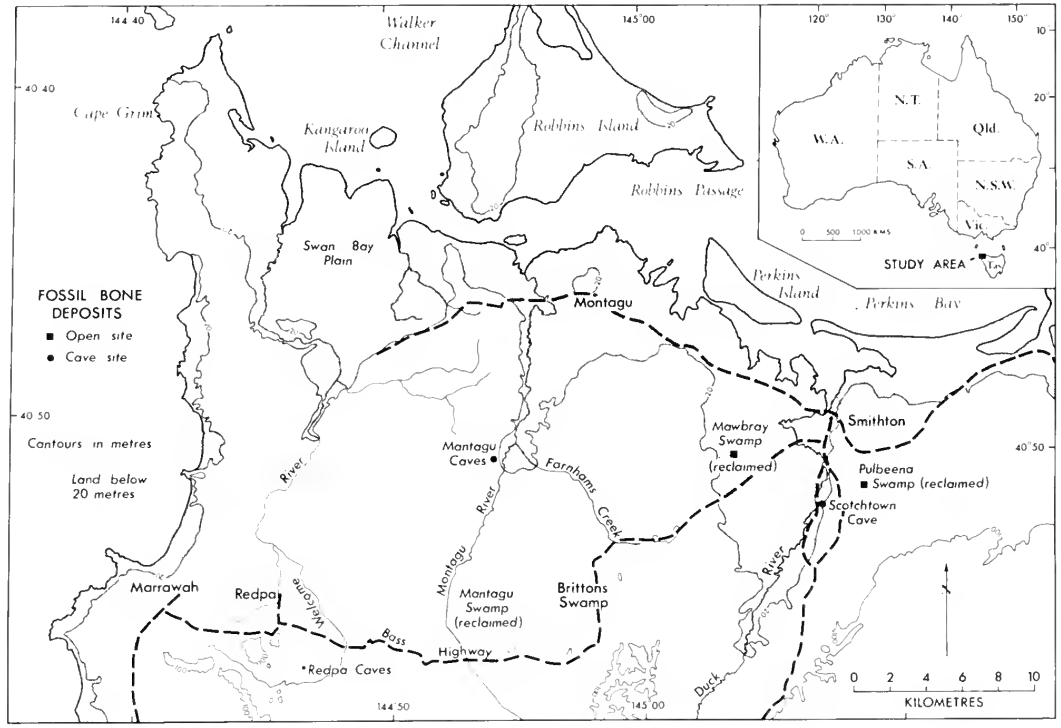


Figure 1 Location map of northwestern Tasmania

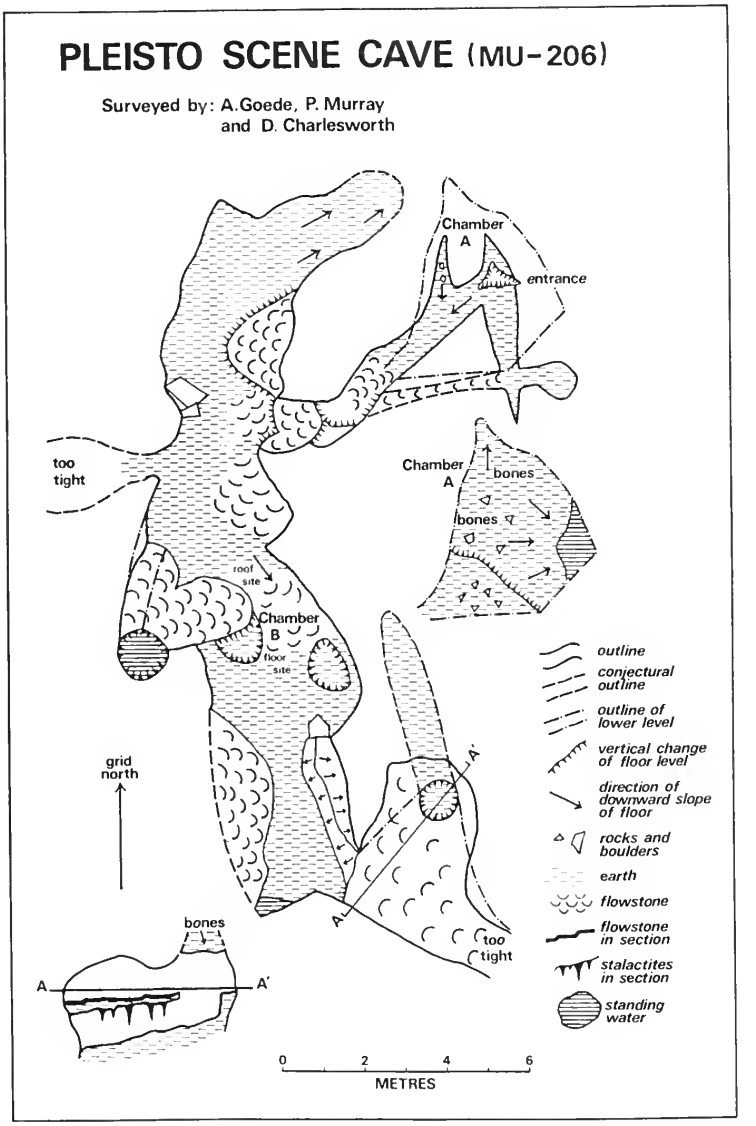


Figure 2 Survey of Pleisto Scene Cave, Montagu

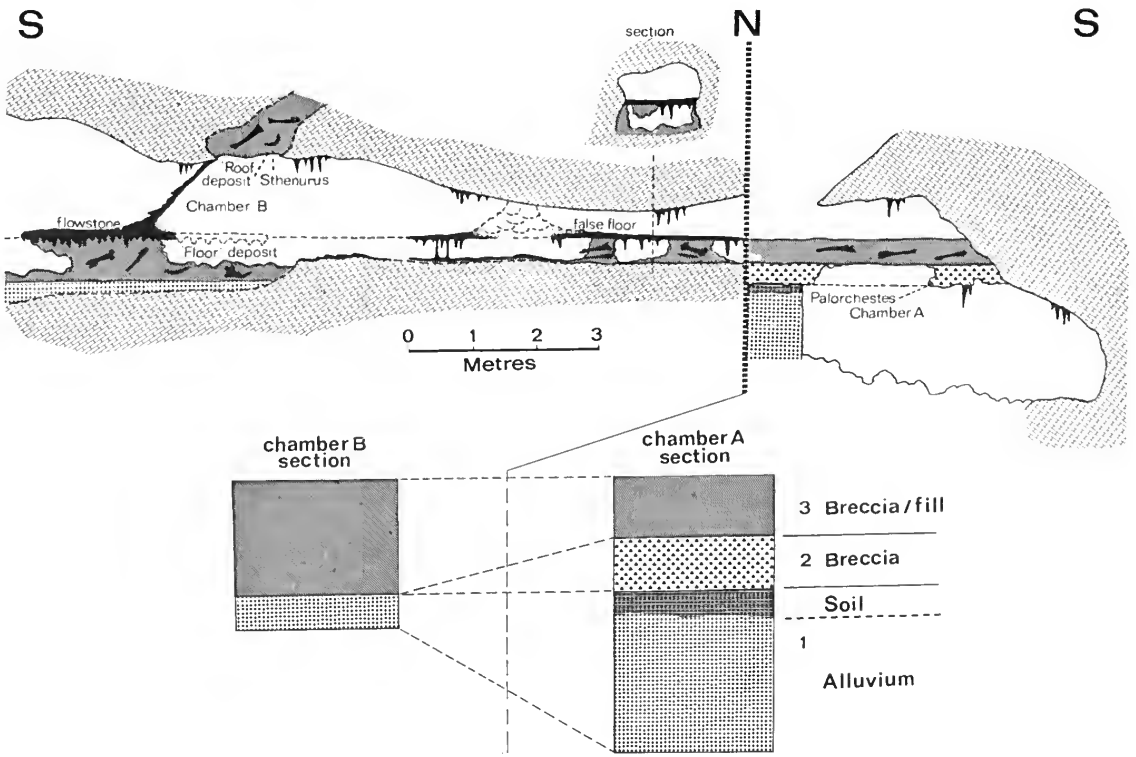
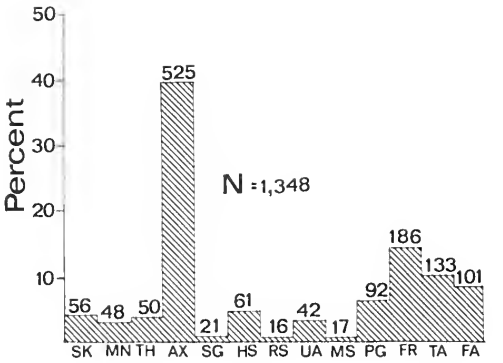
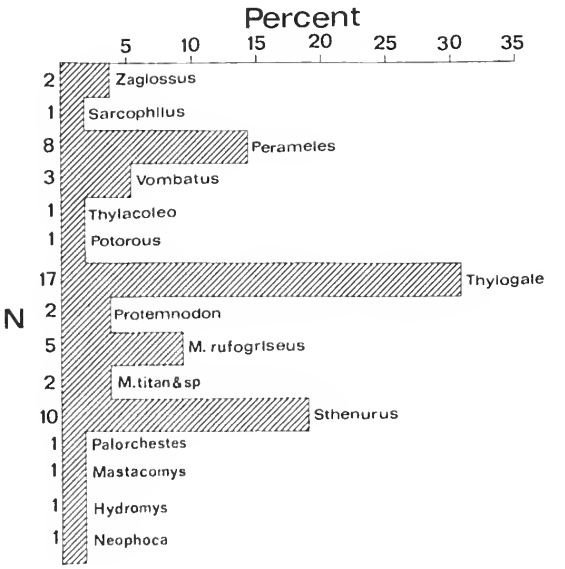


Figure 3 Diagramatic drawing of the stratigraphy of Mu-206. Chamber A is reversed in its long axis to aid in showing stratigraphic continuity with Chamber B. Diagram below shows inferred stratigraphic relationships between the two chambers. Note the absence of Bed 2 in Chamber B.



a



b

Figure 4 a Proportion of all identifiable bones expressed as a percentile histogram. The graph shows all fragments prior to assessment of a minimum number. Bold numerals indicate the number of each element recovered. SK, skull; MN, mandible; TH, teeth; AX, axial (ribs and vertebrae); SG, shoulder girdle; HS, humerus; RS, radius; UA, ulna; MS, manus; PG, pelvic girdle; FR, femur; TA, tibia; FA, fibula.

b Minimum number of individuals of each species from Bed 3B expressed as a percentile histogram. Bold numerals give the minimum number.

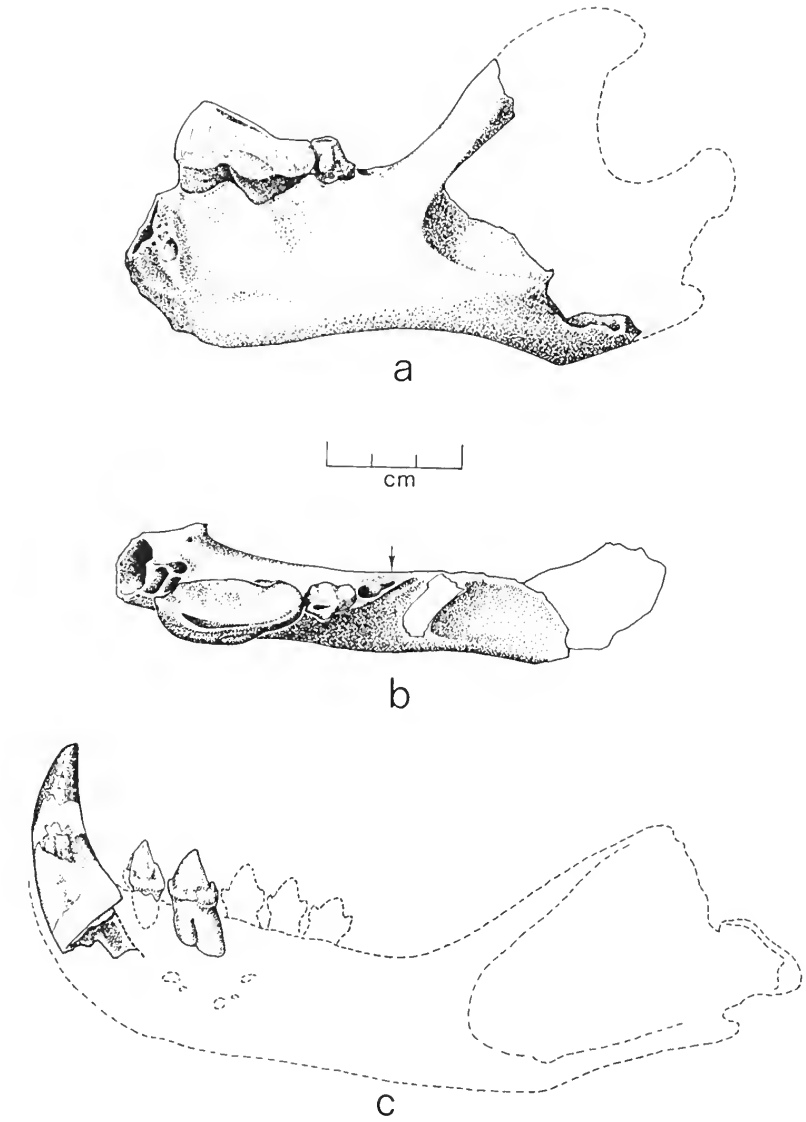


Figure 5 a Side view of left hemimandible of *Thylacoleo carnifex*, ascending ramus restored.

b Occlusal view of mandible. Arrow indicates possible M_3 alveolus.

c Left canine, P_4 and M_1 of *Neophoca*. Scale equals 3 cm.

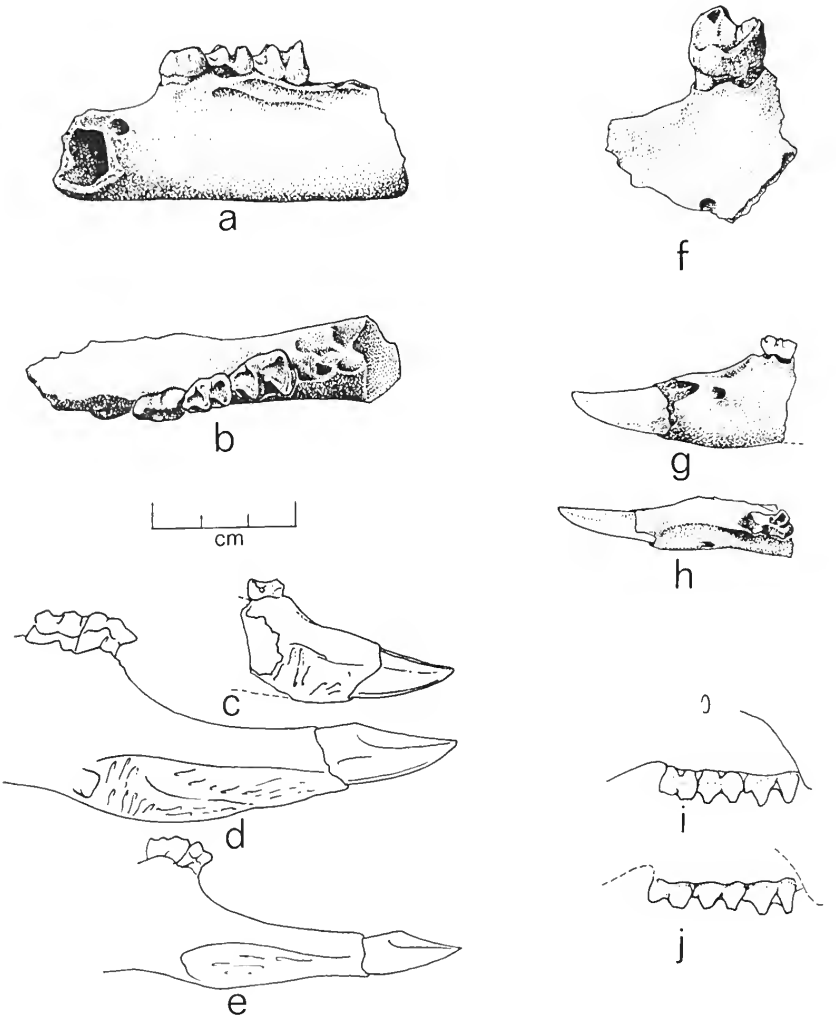


Figure 6 a Left mandibular fragment of *Protemnodon anak*.
b Occlusal view showing P_2, DP_3 and M_1.
c Outline of *Macropus titan* mandible fragment from Montagu compared with
d *M. titan* (Florentine Valley).
e *Macropus giganteus* (Ross, Tasmania).
f Left P_3 of unidentified diprotodontid (?*Zygomaturus*).
g Labial side of mandible of *Macropus titan*.
h Occlusal view.
i *Macropus giganteus* P^2, DP^3 and M^1 from Ross, Tasmania compared with
j *Macropus* sp., Montagu.

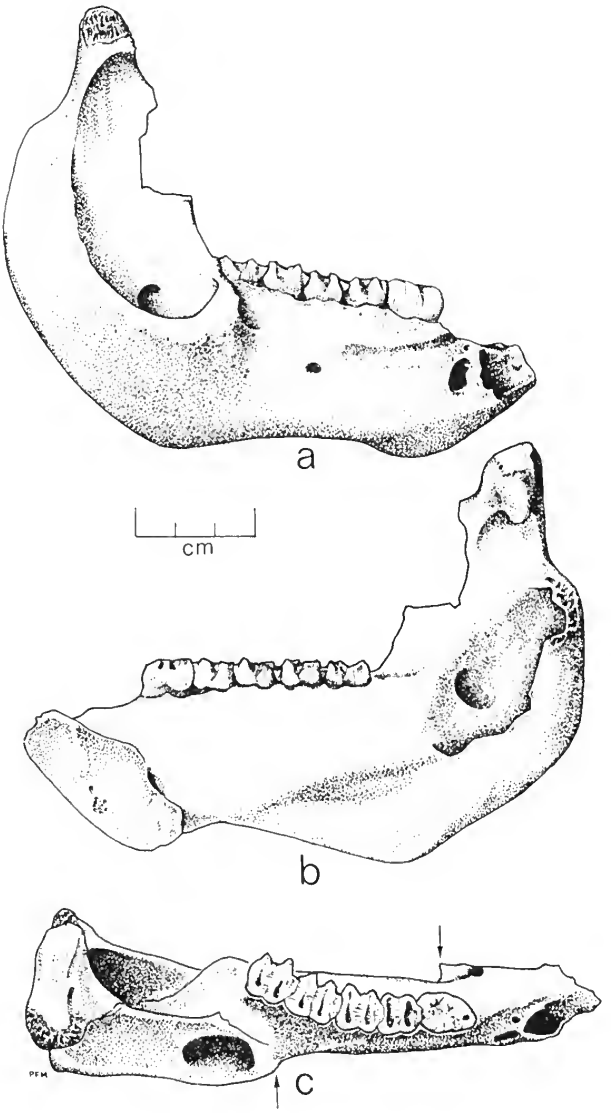


Figure 7 a Labial view of right hemimandible of *Sthenurus occidentalis*.

b Lingual view.

c Occlusal view. Arrows indicate posterior margin of mandibular symphysis and the anterior root of the ascending ramus. Dentition is P_3, M_1-M_4.

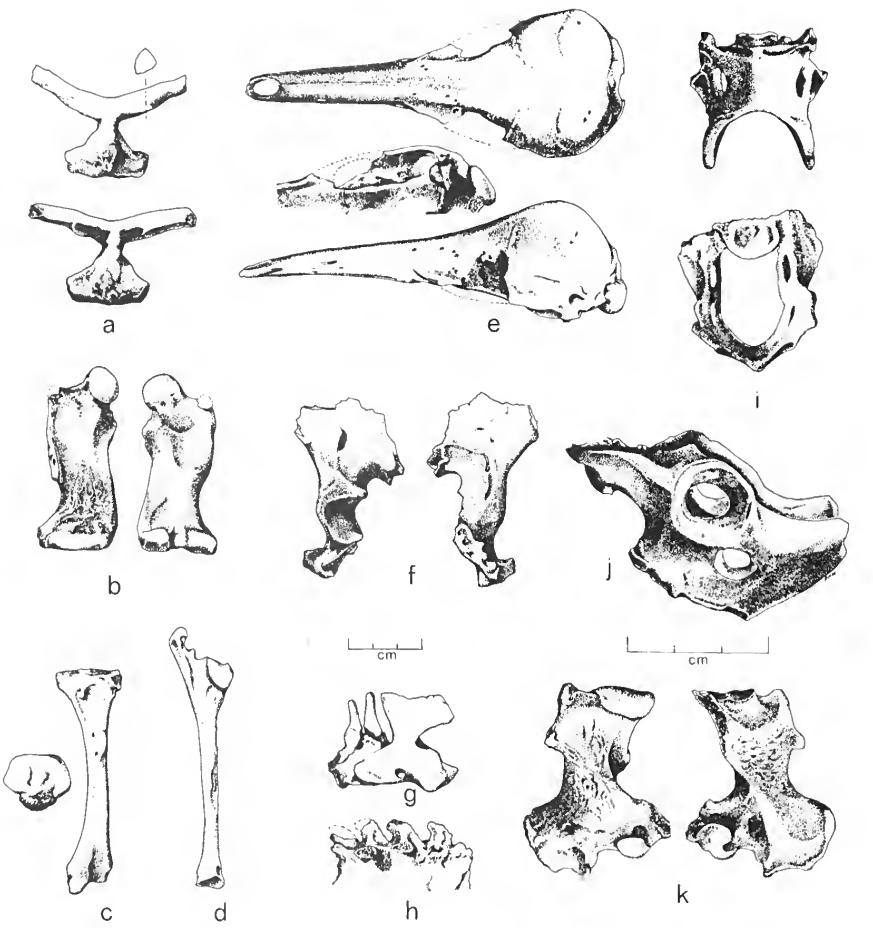


Figure 8 *Zaglossus* sp.

a Episternum and clavicles.
b Right femur.
c Right tibia.
d Left fibula.
e Cranium.
f Right scapula.
g Axis, C3-4.
h Thoracic vertebrae.
i Ventral and frontal view of pelvis.
j Side view of pelvis, enlarged to show detail.
k Right humerus.

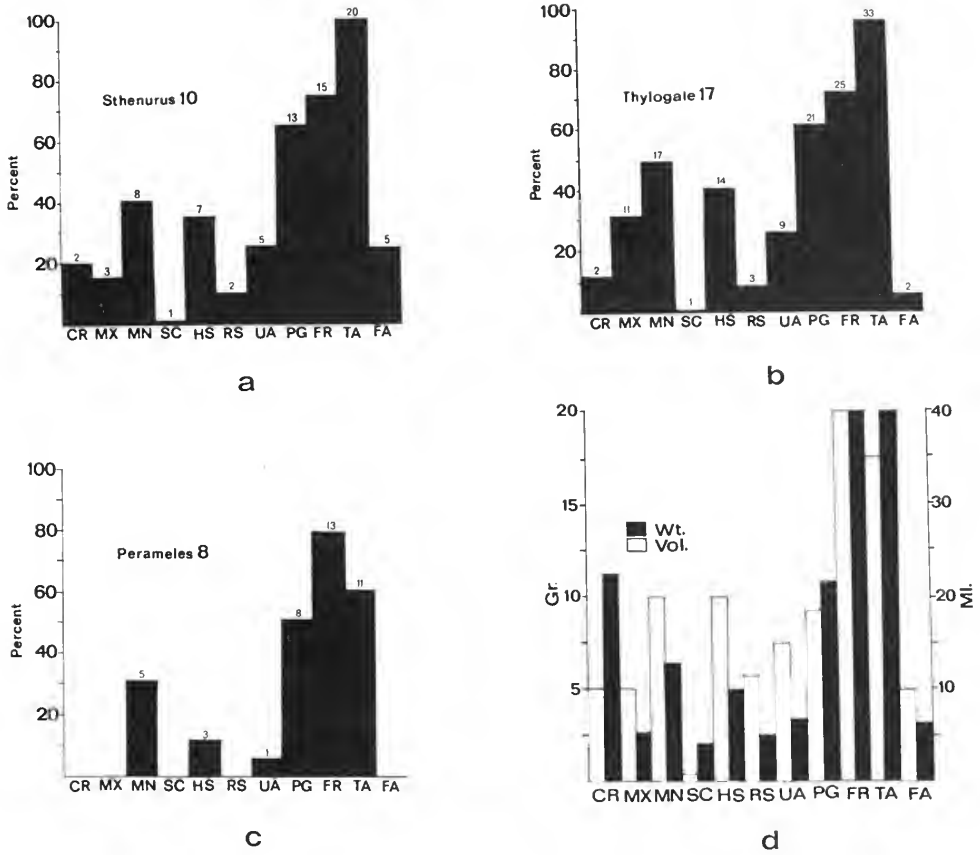


Figure 9 a Percentile histogram expressing differential preservation of skeletal elements in *Sthenurus occidentalis* (certain post-cranial elements are only tentatively assigned to this species). Axial elements have been omitted. One hundred per cent is the expected frequency for each element shown, based on the minimum number of individuals, thus with ten individuals present, there should be a total of 20 specimens of any paired element of that species. Small numerals express the actual number of each element. CR, neurocranium; MX, maxilla; MN, mandible; SC, scapula; HS, humerus; RS, radius; UA, ulna; PG, pelvic girdle; FR, femur; TA, tibia; FA, fibula. Bold numeral = minimum number of individuals.

b Histogram expressing differential preservation of elements of *Thylogale*.

c Histogram expressing differential preservation in *Perameles*.

d Histogram showing the weight and amount of displacement volume of each element of *Thylogale*. Note the similarity in shape of all four histograms.

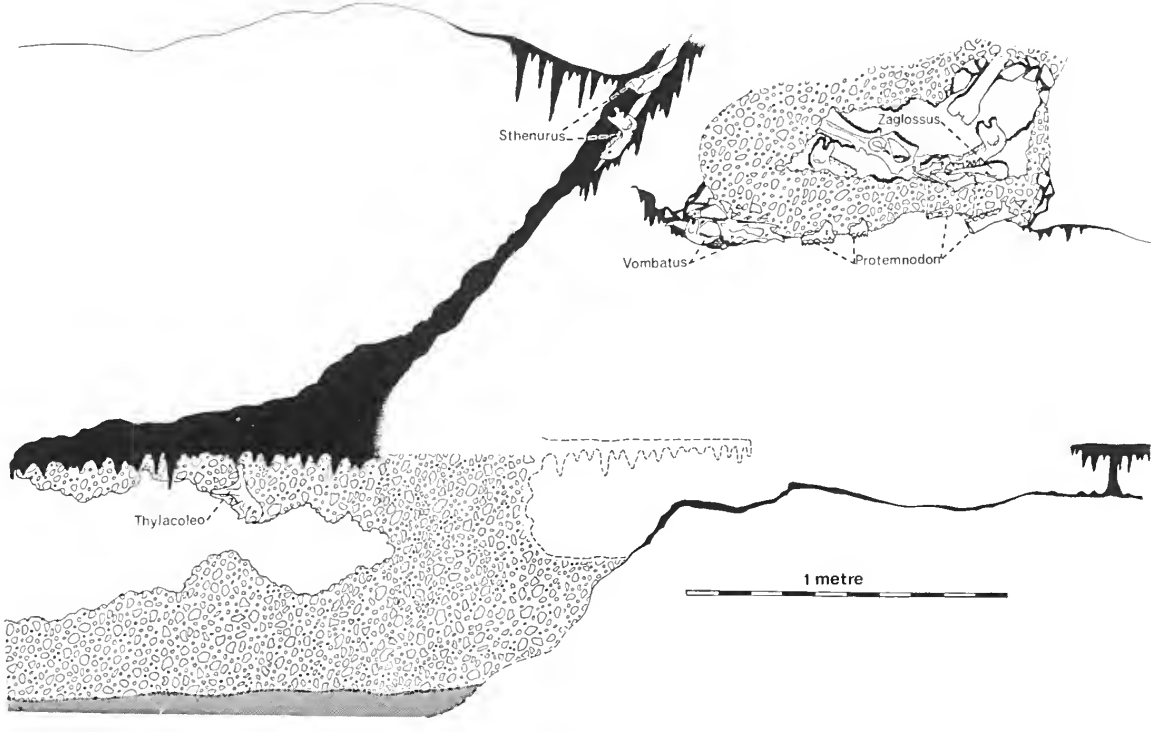


Figure 10 Semidiagramitic drawing of *in situ* fossils in Bed 3B. Scale is approximate, several different planes are depicted as one.

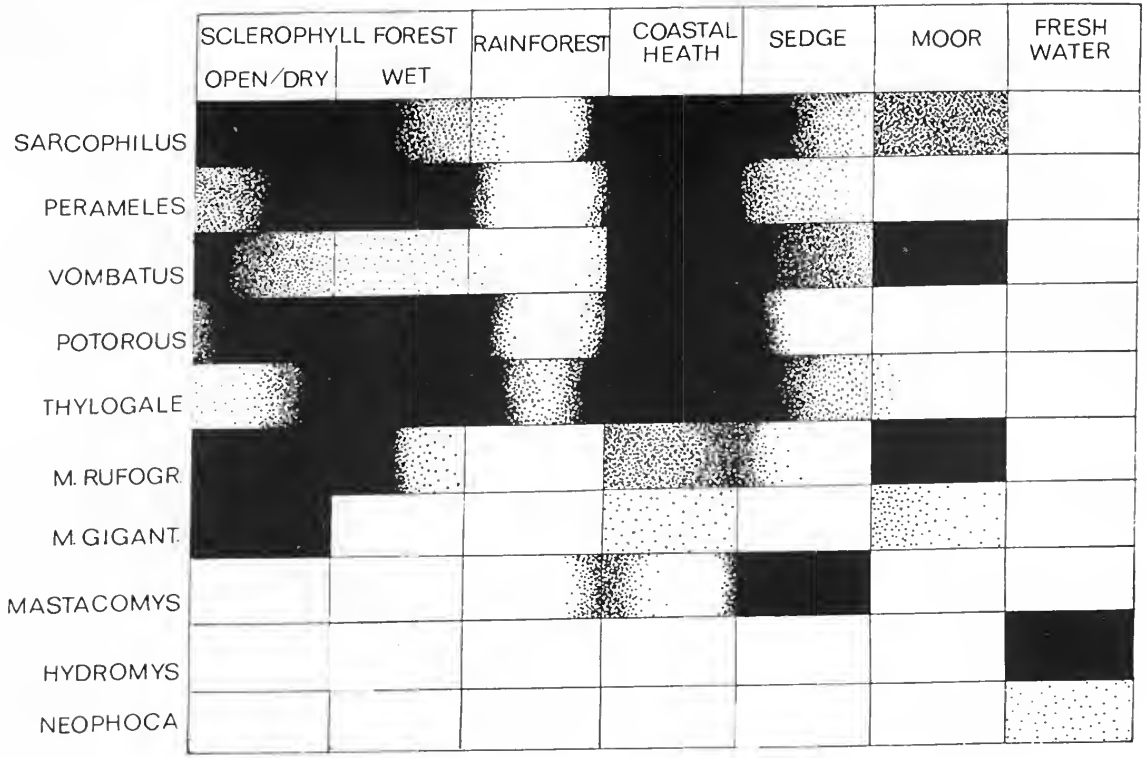


Figure 11 Habitats of living Tasmanian species recovered in Bed 3B. Preference is expressed by the pure black areas. Suboptimal and rare presence is shown by varying the density of stipples. Ecotones are expressed by continuity of shading between borders of listed habitats. All forms shown in rainforest areas are known to occur only on the verge or edge of the habitat.

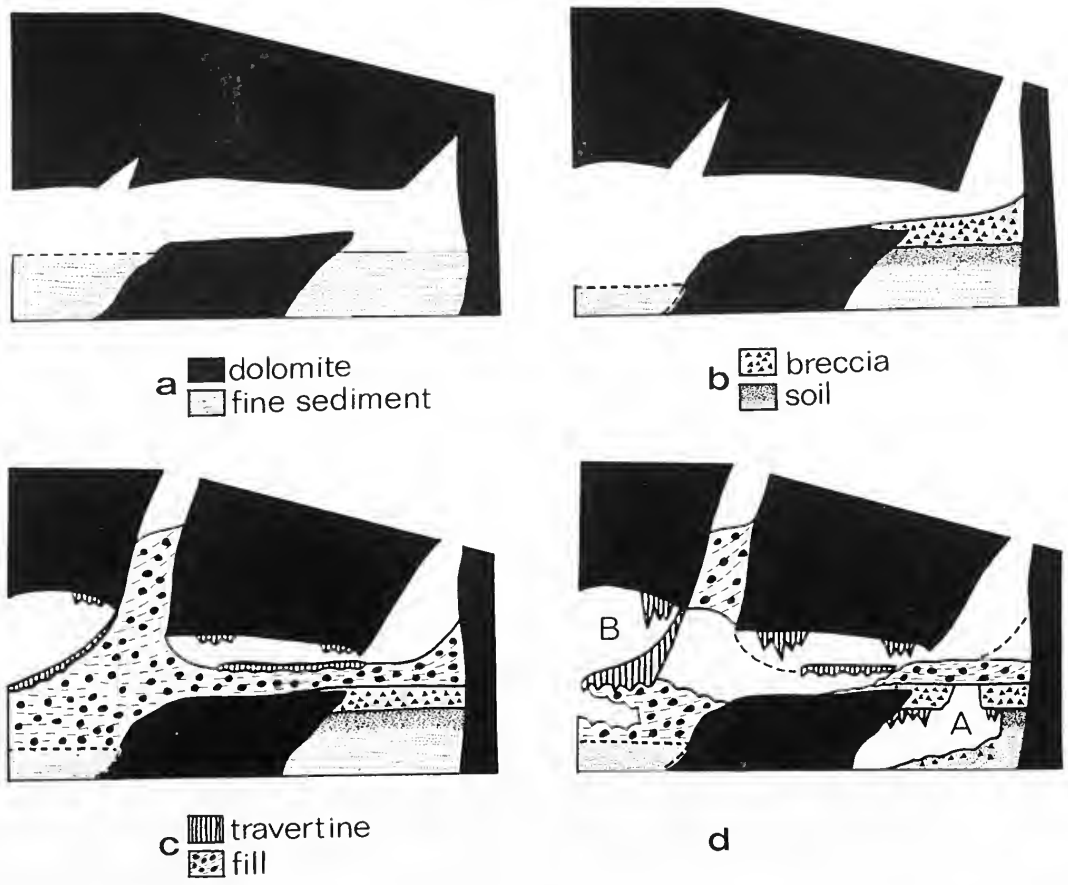


Figure 12 Sequence of events

a Initial alluvial sedimentation.
b Deposition of Bed 2 with the opening of the Chamber A entrance.
c Formation of debris cone, initial flowstone deposition.
d Present.

alveolus. The incisor roots were probably of large diameter. The diastema appears to have been short and the position of the mental foramen relative to the premolar agrees more with *Zygomaturus* than *Palorchestes*. A lower incisor from Bed 3B positively identifies *Palorchestes*.

Table 8. Comparison of measurements of P_3 from *Zygomaturus* and *Palorchestes*

	Length	Maximum Width	Ratio W/L
Montagu ? *Zygomaturus*	16.7	14.1	.84
Tas. Mus. *Zygomaturus*	20.1	16.2	.81
Palorchestes painei (Woodburne, 1967)	12.3	8.3	.67
Palorchestes parvus (Woods, 1958)	14.9	10.6	.71
Palorchestes azeal (Woods, 1958)	17.4	10.4	.60

THYLACOLEONIDAE

Thylacoleo carnifex, Owen 1859

Material: Fragment of horizontal ramus containing P_3 and M_1 (figure 5a, b).

Description: This is a young small adult individual with moderate wear on the P_3 and M_1. It is distinguished from typical specimens of *Thylacoleo carnifex* in possessing a narrow, shallow alveolus posterior to the M_1. This may represent the socket of a tiny third molar.[2] The length of the P_3 crown of the Montagu specimen is also relatively short, perhaps in association with the presence of a third molar. A comparison of Tasmanian and Mainland specimens is given in Table 9.

Table 9. Measurements of *Thylacoleo carnifex* mandibular dentitions

	Depth ramus Posterior top $P_{\bar{3}}$	Length Crown $P_{\bar{3}}$	Length Crown $M_{\bar{1}}$	Ratio $M_{\bar{1}}$ / $P_{\bar{3}}$
Montagu	39.5	32.5	11.5	.35
F745 (Woods, 1956)	50.0	40.7	-	-
F2927 (Woods, 1956)	44.0	-	13.7	-
F2929 (Woods, 1956)	44.0	39.3	13.2	.34
F748 (Woods, 1956)	37.0	35.3	11.9	.34
F2928 (Woods, 1956)	44.0	39.2	13.8	.35

Table 10. Measurements of *Thylacoleo carnifex* from Montagu

Symphysis L x W	Thickness ramus at $P_{\bar{3}}$	Thickness ramus at $M_{\bar{2}}$	Incisor alveolus L x W	$M_{\bar{2}}$ alveolus L x W	? $M_{\bar{3}}$ alveolus L x W
24.0 x 23.0	19.2	15.8	20.3 x 9.4	4.4 x 3.5	3.0 x 1.0

2 Woods (1956: 140) noted a depression immediately posterior to the second molar of a specimen which he interpreted as the alveolus of a small M_3.

TACHYGLOSSIDAE

Zaglossus, Gill 1876
Zaglossus sp.

Materials: Skull lacking mandible, axis, cervical vertebrae 3-4, thoracic vertebrae 1-3 or 2-4; sacral vertebra 1, episternum, clavicles, sternal fragments, ribs, right and left humeri, fragment of additional left humerus, two right scapulae, and one left scapula, right and left femora, right and left fibulae, right and left tibiae and innominate bones missing the ilia (figure 8).

Description: Sufficient information for the recognition of the genus is provided by figure 8. The femur of a similar form was described by Scott and Lord (1922) as a new species, *Zaglossus harrissoni*. The skull of the Montagu specimen is within the metric range of living *Zaglossus bruijnii* and it is morphologically similar to that species. Specimens described by Dun (1895)[3] and Glauert (1914) as *Zaglossus hacketti* are considerably larger than the Tasmanian form. Material from Mammoth Cave has certain morphological differences in addition to size that distinguish it from the Montagu form (Glauert, 1914).

Table 11. Condylobasal lengths of *Zaglossus bruijnii* and *Zaglossus* spp.

Montagu	AMNH (Van Deusen, 1969)							(Dun, 1895)
	190859	190862	190863	66194	194702	104020	105072	Gulgong
165.0	203.0	186.0	193.0	168.0	154.0	180.0	158.0	265.0 (est.)

DISCUSSION

The Montagu Bed 3B fauna is similar to the assemblage from nearby Scotchtown Cave. The Montagu fauna lacks two additional *Sthenurus* species (*Sthenurus ?orientalis* and *Sthenurus ?andersoni*) recently identified in the Scotchtown Cave material (P. Murray, in preparation). Both Montagu and Scotchtown Cave contain a subspecific variant of *S. occidentalis* distinguished from the type by the characters given in the fauna description section of this paper.

PRESERVATION

A sample of 1,348 identifiable elements were analysed. The overall pattern of elements recovered indicates a predominance of limb bones and axial elements (figure 4a). Larger animals are more common than smaller ones.

Significant differential preservation was detected by noting the relative scarcity of small mammal remains and small skeletal elements of larger species in the screened bulk samples. The factor of differential preservation was tested by statistical examination of the remains of the most common species in the assemblage: *Thylogale*, *Sthenurus* and *Perameles*. A minimum number of individuals for each of these species was determined. This permitted the establishment of an expected frequency of all other skeletal elements for the bones belonging to that particular species. The observed frequency for each bone was then expressed as a percentage of the expected frequency (figure 9a, b, c, d). The shape of each histogram is remarkably uniform for each of the three species. Tibiae, femora and pelvic elements predominate. Mandibles are relatively common. Rare are scapulae, neurocrania, fibulae and radii. Differential preservation may have been due to the gradual decomposition of the less massive bones. Assuming that the robustness of each bone could be expressed in weight, a sample of *Thylogale billardieri* bones were weighed and plotted. The

3 Dun may have greatly overestimated the length of the skull of his specimen. An estimate based on the Montagu skull presents a figure closer to 180 mm total length for the Gulgong *Zaglossus*.

relative compactness or surface area of each bone was estimated by measuring the amount of fluid displaced.

These findings were scaled to the size of the expected frequency histograms for ease of comparison (figure 9d). The close correspondence of the weight/displacement histogram to the shape of the histograms of observed frequencies of elements clearly suggests that the lighter and thinner the bone, the less likely its preservation.

POSSIBLE CAUSES OF FAUNAL ACCUMULATION

Caves are among the best environments for the accumulation and preservation of bones of Recent and Pleistocene animals (Kurten, 1968). The most frequent causes for fossil deposits in caves include use of the cave entrance as a human occupation site, with the bones representing food refuse; the occupation of the cave by hibernating animals (Kurten, 1968), and the use of the cave by carnivores and scavengers, in which case there are remains of its prey, and sometimes remains of the responsible carnivore.

Many caves have treacherous vertical shafts leading to the surface forming natural pitfalls that may trap unwary animals. Animals may be attracted to karst areas because cave openings and overhangs offer shelter. Certain food plants may also grow more prolifically on the carbonate rich soil of the limestone exposures.

THE DEBRIS CONE

Evidence from stratigraphy and geomorphology combined with the statistical analysis of the fauna indicates that the Bed 3B deposit is the remains of a debris cone. The eroded remains of this fan of extraneous sediments originate from the steeply inclined shaft leading to the surface. The entrance of this shaft or fissure has been choked by soil and debris and its exact location is unknown. We have determined however, that the material in the roof is not a clinging remnant of a previously choked horizontal passage. This helps to rule out the possibility that the fossils and sediments were washed in by stream activity.

Configuration of flowstone sheets indicates the original shape of the debris cone (figures 3, 10). In the "floor" site, the greatest concentration of fossils is along the walls in the lowest deposits of cave fill. The debris cone was located in the centre of a rather narrow passage, where erosional activity was concentrated. The deposit gravitated to the sides of the chamber and small recesses in the floor.

CAUSES OF BREAKAGE OF THE BONES

The fossil bone from Bed 3B is permineralized, brittle and often deeply stained with mineral salts. The preservation of bone is extremely poor in the clay-rich sediments (Bed 1B) near the base of the exposed Chamber B "floor" deposit. Excellent preservation of bone is found in the "roof", from the "floor" breccia and from loose stony fill beneath. Nearly all of the specimens are coated with hard calcined matrix. Broken material is common. Ribs are invariably fragmented, as are some of the more robust long bones. Breaks in long bones tend to follow the alignment of osteons. The delicate processes of vertebrae are frequently missing. A *Protemnodon* mandible in the roof deposit appears to have been sheared. Other "sheared" long bones could be seen throughout the deposit where the matrix was undercut by erosion, causing a portion containing part of the specimen to fall under its own weight. Most of the fractures appear to be clean, post-depositional breakage caused by slumping, faulting and creeping of the matrix. Considerable slow, low energy movement of the deposit is indicated.

A few broken bones suggest that damage occurred at the time of deposition. These breaks are characteristic of fresh bones. Spiralled breaks with bevelled and hinged edges may have been caused by the impact of the animal's fall down the shaft.

Evidence of activity of carnivores and scavengers is also present. Three or four specimens have rodent tooth marks and one is extensively damaged by gnawing. A single *Macropus rufugriseus* tibia shows definite evidence of having been chewed on its proximal and distal ends by a larger carnivorous species. Some bird remains (*Rallidae*) show evidence of chewing on the extremities of long bones. These were probably chewed by small scavengers or carnivores. Emu remains are undamaged.

The bulk of the fossil material appears to have been unharmed by scavengers or carnivores. Many of the typical signs of carnivorous activities are absent: the ascending rami are present in many of the mandibles, the epiphyseal regions of long bones tend to be undamaged. The bones of small animals when present, tend to be whole and unmarked. Characteristic tooth marks of carnivores are uncommon (see Douglas, *et al.*, 1966).

The balance of evidence indicates that the fossil remains resulted from animals falling into a steeply inclined shaft. Some scavengers and carnivores may have been attracted by the presence of other trapped or decaying animals. It is probable that animals capable of scrambling could move in and out of the shaft. This would be particularly likely in the case of rodents, small dasyurids and *Sarcophilus harrisii*. All are exceptional climbers. Terrestrial birds such as emus and native hens would be expected victims of the pitfall. The lack of other birds, passerines, ducks and plovers, also tends to favour the secondary role of carnivore activity as a source of the fossils. A wide range of birds would be expected if this were to represent the refuse of active carnivores.

PATTERN OF REPRESENTATION

A final argument that tends to rule out carnivorous activity as a primary cause of the bone accumulation in Bed 3B is found in the pattern of representation of skeletal parts. Bone accumulations resulting from the activity of carnivores appear to have a different pattern of representation to that found in Bed 3B. An interesting faunal analysis of a South African site (Swartklip 1) by Klein (1975) provides an excellent example. At Swartklip I and Makapansgat the proportion of femora and tibiae is relatively much lower while mandibles are considerably more frequent. Other elements show a similar, rather great discrepancy in relative abundance between the South African sites and the Tasmanian one. In addition, Klein found a quite different ratio between proximal and distal ends of certain long bones. In Bed 3B these are in approximately equal proportions. Fractures are also less frequent in the Montagu deposit.

ECOLOGICAL IMPLICATIONS

The most common living macropodine species represented as fossils in Bed 3B (*Thylogale, M. rufogriseus*) are presently widely distributed and are associated with many different communities. *Thylogale billardieri* prefers damp areas with dense vegetation. Fern gullies, the verges of rainforest and heathland in the presence of tall dense scrub, are favoured habitats (Green, 1974: 375) (figure 11). *Macropus rufogriseus* is found in habitats ranging from coastal heathland and rainforest verges, to open subalpine areas. It prefers drier areas of sclerophyll forest (Green, 1974: 375). *Macropus giganteus* prefers drier open sclerophyll forests (Green, 1974: 374). It is likely that *M. titan* also preferred open dry habitats. The high abundance of *Thylogale* in the deposit may reflect an optimum habitat for that species. The brush wallaby (*M. rufogriseus*) is somewhat intermediate between the two in its habitat preferences. Evidence from modern cave faunal accumulations shows that in optimum habitats for *Macropus giganteus* there is a greater frequency of that species than of either *Thylogale* or *M. rufogriseus* (P. Murray, unpublished data on caves at the Quoin, near Ross, Tasmania). This suggests that the fossil habitat was suboptimal for *Macropus giganteus* and by inference *M. titan*, and perhaps marginal for *M. rufogriseus*. This implies the presence of scrub, also perhaps wet conditions.

Perameles gunnii prefers open habitats with low ground cover (Heinsohn, 1966), in contrast to *Isoodon* which is more restricted to locally abundant dense wet scrub and coastal heath. *Perameles* is common in the deposit while

Isoodon is absent. This implies that the immediate area was relatively open.

The single specimen of *Potorous* suggests the presence of dense natural vegetation. The species is common in coastal heath communities and in areas with low, dense ground cover (Heinsohn, 1968). The relative scarcity of the species in the deposit suggests that the immediate area was more likely open than covered with dense scrub or forest. Its presence does suggest the existence of a scrub or densely vegetated area nearby, assuming that the cave mouth was within its home range.

The presence of *Mastacomys fuscus* in the assemblage suggests the possible presence of a wet, perhaps treeless sedgeland, its almost exclusive present habitat (Green, 1968, 1974).

The living species of *Zaglossus* is poorly known. It is presently confined to humid montane forests (Van Deusen and George, 1969).

Rails prefer wet areas with dense vegetation. *Tribonyx* occurs in grassy vegetation including the edges of swamps and creeks, and tussocks (Slater, 1970). Emus prefer open grasslands, savanna parklands and scrub.

Hydromys is associated with a wide variety of fresh and brackish water habitats (MacNally, 1960). The presence of both the water rat and *Neophoca* can be explained by the proximity of the site to the Montagu River. The proclivity for sea lions to ascend rocky prominences on which to rest and sun themselves suggests the likely course by which the animal became part of this otherwise non-littoral assemblage. *Neophoca* could also represent the prey of a carnivorous species. This still does not account for its inland occurrence. It is highly unlikely that the remains would be carried more than 10 km unless the teeth represent the durable contents of carnivore dung.

Habitat preferences of extinct species must be inferred on the basis of their morphology, or when possible, a combination of their anatomy and evidence from geomorphology or palaeobotany. *Sthenurus occidentalis* has low molar crowns and trenchant lophs characteristic of a browser. Its high abundance in Bed 3B indicates that a suitable leafy forage was locally available, perhaps in the form of heaths, scrub or a low, open forest community. Raven and Gregory (1946) suggest that *Sthenurus* was a forest-preferring species. The animal's large size and inferred locomotor capability does not favour a dense, closed forest of the type present today at Montagu.

The dentition of *Protemnodon anak* suggests that the animal was a grazer (Raven and Gregory, 1946). It is slightly more common than *M. titan*. The presence of *Protemnodon anak* and *Macropus titan* suggests that suitable grazing habitats were locally present.

The faunal evidence favours an open or partially open habitat with the presence of dense scrub, or digitations of low wet sclerophyll and/or rainforest. A formation consisting of wet hummock sedgeland with bordering scrub and forest associations, similar to those present in the northwest coastal area of Tasmania today would not be inconsistent. Grassland was probably present nearby. The greater compliment of macropod species in the Scotchtown Cave assemblage may be a reflection of the distal grassland community.

The fauna favours the interpretation that the habitat was wet, though perhaps not as wet as analogous modern coastal lowlands on the west coast of Tasmania.

SEQUENCE OF EVENTS

The following is an attempt to synthesize the geomorphological and palaeontological findings. The major stages of cave evolution and deposition of the sediments are summarized in figure 12a-d. The initial phase of sedimentation in the cave (figure 11a) has already been described. The accumulation of Bed 2

probably occurred at some time after a fissure had reached the surface. That fissure is now the entrance to the cave system. The production of the breccia probably took place during a cold dry phase. Some mammals had become trapped in the deposit in a manner probably not unlike their occurrence in Bed 3. Deposition of Bed 3 suggests a period when solution weathering of the dolomite was dominant over frost fracturing. The large amount of sediment, and the extent to which active movement of the material took place suggest a period of active cold climate soil mobilization. The tendency for the dolomite fragments to be larger and more rounded than in Bed 2 is consistent with a cold, wet environment. This agrees with the evidence from the fauna. More sediment and trapped animals continued to accumulate into a debris cone. A flowstone layer formed over the debris cone and its fan extending up and down the surrounding passages. Active creeping of the sediment took place throughout the depositional period which accounts for the extensive scattering and breakage of the fossils. The debris cone may have been partially eroded away at various times during this phase until the shaft became clogged and the sediments within consolidated by calcification. A final stage of erosional activity locally washed the sediment from beneath the flowstone layer leaving false floors.

AGE OF BED 3B

Radiometric dates: Bone collagen dates from Bed 3B suggest a possible terminal Pleistocene age for the deposit. Sample R5001/2 (N.Z.) from the floor of Chamber B yielded a ^{14}C date of 10,100 ± 200 years B.P. An apparently anomalous date of 1,450 ± 210 years B.P. [R5001/1 (N.Z.)] was obtained from the bone of an extinct species in the "roof" deposit. We suggest that the 10,000 year date is a minimum age for the site and that the anomalously young date is due to extensive replacement of the bone.

A terminal Pleistocene date is not incompatible with the stratigraphic evidence. The angular dolomite fragments in Bed 2 could be interpreted as the maximum cold phase of the second hemicycle of the last glaciation. Bed 3 dolomites are more rounded and larger, suggesting increased solution activity during a less cold and probably wetter climatic phase. Bed 3 may therefore represent the terminal Pleistocene or a late stadial. There is no deposit above Bed 3, even though the entrance to the system above Chamber A has apparently remained open since its deposition. This would support the inference that Bed 3 represents the final depositional phase of the last glacial stage.

SUMMARY

The Bed 3B faunal assemblage consists of 1,348 identifiable skeletal elements out of a total of slightly less than 2,000 specimens. An estimated minimum of fifty individuals representing a variety of mammals, a small number of birds and one reptile had become trapped or were killed when they fell into an open fissure leading into a small cave system. There is indication of the activity of carnivores and scavengers having modified some of the remains before they were completely buried by extraneous sediments. Several species of mammals in the deposit are identical with modern Tasmanian species. These include *Thylogale billardieri*, *Macropus rufogriseus*, *Potorous tridactylus*, *Mastacomys fuscus*, *Hydromys chrysogaster*, *Vombatus ursinus*, *Sarcophilus harrisii*, *Perameles gunnii* and an otariid belonging to the genus *Neophoca*. A large tachyglossid has been assigned to the living genus *Zaglossus*. Several species of extinct megafauna are also present. These include *Sthenurus occidentalis*, *Protemnodon anak*, *Macropus titan*, *Palorchestes*, *?Zygomaturus* and *Thylacoleo carnifex*. *Sthenurus occidentalis* is especially well represented.

In Tasmania, *Sthenurus occidentalis* is far more common than the eastern Australian species *Sthenurus orientalis*. The birds present include emu, and a rallid (*?Tribonyx*). The fauna suggests that at the time the Montagu area was more open than at present, with local dense scrub associations. A seasonally wet substrate is indicated. Grassland was present but not extensive. Evidence from the fauna and the Bed 3B sediments suggests that the environment was cold and wet at the time the animals lived.

Three strata of cave sediments consist of 1) a water born fine sediment having a soil horizon; 2) a frost fractured dolomite containing little matrix; and 3) a cave fill containing fauna and dolomite fragments reflecting some solution activity. These indicate substantial changes over time in the depositional environment at Montagu. The fine sediments in Bed 1 may have been deposited at the beginning of the Last Glacial phase. Deposition of Bed 2 probably reflects a cold, dry phase following an interstadial suggested by the cave soil developed on Bed 1. A subsequent cold wetter phase led to the deposition of Bed 3. Dating of bone collagen by the ^{14}C method suggests that the fauna in Bed 3B lived at the end of the Pleistocene, possibly as late as 10,000 years ago. This implies that Bed 2 deposition reflects the late Last Glacial phase of maximum cold (approx. 20,000 B.P.).

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APPENDIX

SPECIES

SPECIES	CHAMBER B (MU-206)	CHAMBER A (MU-206)	MAIN CAVE (MU-201)	MU-203	FLOWERY GULLY	SCOTCHTOWN	MOWBRAY SWAMP	PULBEENA SWAMP	BEGINNERS LUCK**	KING I	FLINDERS I	CAPE BARREN I	PASSAGE I	PRESERVATION I	E. KANGAROO I	DEAL I	ERITH I	THREE HUMMOCK I
	MONTAGU				NW TAS			S TAS			BASS STRAIT ISLANDS							
AVES	X	X				X	X	X	X	X	X	X	X	X	X	X	X	
REPTILIA			X			X				X	X	X		X	X	X	X	
Tachyglossus				X	X	X				X	X							
*Zaglossus**	X		X			X				X								
*Macropus titan**	X					X												
Macropus giganteus	?		X	X	X											?		
Macropus rufogriseus	X	X	X	X	X	1	4		X	X	X	X		X		X	X	
Thylogale billardieri	X	X	X	X	X			X	X	X	X	X	X		X	X	X	X
Potorous tridactylus	X	X	X		X						X	X				X		X
Bettongia cuniculus					X													
*Protemnodon anak**	X					X				X								
*Sthenurus occidentalis**	X		X			X	3		X	X								
*Palorchestes azeal**	X	X				X	X	X										
*?Nototherium**						X	X			X								
*Zygomaturus**	?						X			X								
*Diprotodon**										X								
Trichosurus vulpecula					X								X			X	X	
Pseudocheirus convolutor			X		X					X	X	X						
Cercartetus nanus					X													
*Thylacoleo carnifex**	X					X												
Vombatus ursinus	X	X	X	X	X	X	5		X	X	X	X				X		
*Phascolonus**							X											
Isoodon obesulus					X						X	X	X					X
Perameles gunnii	X		X		X	X			X									
Antechinus spp.					X					X	?			?		?		
Sminthopsis					X													
Dasyurus viverrinus					X				X						?			
Dasyurus maculatus				X	X				X	X	X	X						
Thylacinus cynocephalus	X				X	X												
Sarcophilus harrisii	X				X	X					X							
Mastacomys fuscus	X				X				X									
Pseudomys higginsi					X		2		X	X								
Rattus lutreolus					X					X	X	X	X	X		X	X	
Hydromys chrysogaster	X																	
CHIROPTERA					X													
PINNEPEDIA (Neophoca sp.)	X																	

FOSSIL LOCALITIES

1. Listed as "wallaby" in Gill and Banks (1956)
2. Listed as "rodent" in Gill and Banks (1956)
3. Listed as "kangaroo" in Gill and Banks (1956) identified as either *Procoptodon* or *Sthenurus*, see p. 23 (ibid.)
4. Confusion arises here as to what is meant by "wallaby". Gill and Banks (1956: 23) suggest that this is *Macropus rufogriseus*
5. *Vombatus* was actually not recovered from the swamp deposit, but from a nearby cave (ibid. p. 23)

* Extinct, or as in the case of *Zaglossus*, extinct in Tasmania and Australian mainland

** Recently discovered fossil cave in the Florentine Valley, Southern Tasmania